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The Acura AR24e power unit was developed by Honda Racing Corporation, US to bring electrification to the Precision Crafted Performance of Acura's endurance sports car racing program. The complete hybrid power unit is based around the Acura AR24e internal combustion engine (ICE), an all-new bespoke 2.4-liter, twin-turbocharged direct injection racing V6 that was designed, developed and manufactured by HRC.

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LESSONS FROM THE FALL OF WORLD RX

RALLYCROSS was my first love. It was vying for a place in my affections with Michele Mouton, Blondie, and the black and gold John Player Special livery, so you will appreciate how serious I felt about it!

That abiding loyalty to the sport's cause made the hurt still deeper last month when rallycross lost its world championship status. From 2026, the series will contract back to a European-only format, with a token "World Cup" event to maintain a veneer of global reach. For a discipline that, in 2014, launched with packed grids, new markets, and factory muscle, this feels like a bitter downgrade. But it also offers motorsport a valuable case study in how not to manage technological change.

World RX's defining gamble was its switch to electric. On paper, it made sense: the short, explosive sprints of rallycross suited the instant torque of electric motors, and manufacturers in 2018 were loudly promising all-electric futures by 2030. The problem was that rallycross stampeded into EV technology just as the wider automotive landscape was shifting under its feet. Those promises have since been delayed, diluted, or abandoned, leaving motorsport committed to a pathway that no longer matched industry reality.

The infamous Lydden Hill fire of 2023 underlined the new perils of electrified racing. A thermal runaway incident destroyed Special ONE Racing's cars and transporter, and with them the credibility of RX1e safety protocols. Unlike a petrol fire, which can be suppressed and contained, a battery blaze burns hotter, longer, and often reignites. It required specialised firefighting equipment and extended safety cordons – disrupting the calendar, draining budgets, and shaking confidence across the paddock.

Technical logistics also weighed heavily and the cars were expensive, limiting privateer access just as entries were most needed. The global expansion was a case of too far, too fast – especially with a fanbase that remained unconvinced by the EV spectacle. By the time the series sounded the retreat – allowing the return of the internal combustion engine and attempting to trumpet a 'Battle of Technologies' between EVs and ICE – the damage was already done.

It is tempting to look back on the glory days of the World Championship – Holjes packed with fans, Loeb and Solberg trading paint, the intoxicating mix of rallycraft and sprint-race aggression – and wonder where it all went wrong. The truth is simple: electrification, pursued at all costs, outpaced both the market and the grassroots of the sport.

Motorsport must learn from this. Innovation cannot come at the expense of stability, affordability, or safety readiness. EV racing has a future, but rallycross shows what happens when a discipline tries to lead the industry rather than align with it.

Next month's Race Tech World Motorsport Symposium – held at the prestigious Royal Automobile Club in Pall Mall – is themed 'The future of motorsport: is it sustainable?' and deals with precisely these sorts of issues. See you there? RT

Mark Skewis
EDITOR

Hydrogen racing's breakthrough moment

The wait has been agonising. But, having cleared the technical and logistical hurdles confronting the transition to hydrogen, Extreme H is good to go. By **Mark Skewis**

WHEN the FIA Extreme H World Cup launches in Qiddiya City, Saudi Arabia, this month, it will do more than debut a new off-road racing series. It will become the first FIA-sanctioned hydrogen competition anywhere in motorsport – a landmark moment that moves fuel cell technology out of experimental testbeds and into a full-scale racing series on a global stage.

Extreme H will even beat the FIA World Endurance Championship to the track with hydrogen, making it motorsport's most visible proving ground for a technology long tipped to power the clean energy transition.

Building on Extreme E's progression from using hydrogen fuel cells for car charging in Season 1, to powering 80% of its entire event operations with hydrogen by its last event in Season 4, Extreme H will showcase what can be achieved at even greater scale.

Although work has been ongoing in the background for most of the year – with the Pioneer 25 taking its public bow at Goodwood – things have moved quickly since last month's historic multi-year deal with the FIA to deliver the World Cup event. The landmark agreement reaffirms the shared commitment of both organisations to open a new frontier of racing. As yet, it's not the multi-round World Championship hinted at previously, but the hope is that a successful event will pave the way for the achievement of that goal.

Mohammed Ben Sulayem, FIA president, said: "The FIA is committed to supporting competitions that set new benchmarks for sustainability, innovation and equality. This agreement for the FIA Extreme H World Cup demonstrates our belief in hydrogen's potential as a key part of motorsport's evolution. Together, we are laying the groundwork for a more sustainable future for our sport and the wider industry."

Alejandro Agag, the founder and CEO of Extreme H, described the recognition as a turning point. "Signing this multi-year agreement with the FIA is a landmark moment for Extreme H and the future of hydrogen racing," he said. "It reinforces our mission to push the boundaries of sustainable motorsport and provide a global showcase for clean mobility solutions and gender equality on the track."

Agag was clear about the symbolism of the Qiddiya City backdrop for the first event. "It is the ideal launchpad for the FIA Extreme H World Cup, a new frontier for motorsport that embodies purpose, innovation and entertainment," he said. "More than just a race venue, it's a statement of intent – a visually stunning, technologically ambitious location that sets the tone for a new era of motorsport. We are proud to showcase the power of hydrogen and sustainable technology."

At the heart of that showcase is Symbio, the joint

BELOW The Pioneer 25 has completed the equivalent of three entire seasons of racing in its test programme

Photos: Extreme H/FIA

ABOVE The fleet of cars, produced by Spark Racing Technology, is ready for action

venture between Michelin, Stellantis and Forvia, tasked with supplying the hydrogen fuel cell stacks. Crucially, Symbio insisted that the modules used in racing must also feed back into its wider R&D for commercial vehicles, buses and stationary power generation.

Serge Grisin, Symbio's hydrogen and motorsport director, put it bluntly: "If it doesn't push the wider industry forward, it is just spectacle. Our approach ensures the cells we put into Extreme H cars are also informing the next generation of road-going and industrial systems."

The Pioneer 25, Extreme H's spec chassis, is built around a hybridised hydrogen–battery powertrain. Various configurations were tested during development, but the finished design uses a single Symbio StackPack 75 module – a 75-kW unit comprising 400 individual cells – that acts as a generator rather than a prime mover. Fuel cells work by feeding hydrogen and oxygen into a catalyst, which triggers an electrochemical reaction that produces electricity. In this case, the electricity is directed into a Fortescue Zero 36 kWh battery pack mounted low in the chassis. That battery then supplies a pair of Helix motors with up to 400 kW of peak output – more than five times the nominal rating of the fuel cell.

This architecture is deliberate. The fuel cell is sized for steady-state generation, while the battery handles the peaks, delivering instant torque for acceleration and recovering energy under braking. The design reflects heavy-duty transport practice: by keeping the stack in its optimal efficiency window, durability is improved and the same logic can be applied to hydrogen-powered buses and trucks.

Grisin explained the crossover. "The performance Extreme H required was very similar to that on some of the small buses and light duty utility vehicles that we already work with," he said. "There's also a similar level of hybridisation. It's the same technology inside, which makes anything we learn from motorsport directly relevant to those other segments."

> *"A statement of intent – a new frontier for motorsport"*

He added: "If we want motorsport to function as a laboratory for other industries, we must use technology that's applicable to those applications. The stack and the cells in the Extreme H fuel cell are standard. Around the fuel cell itself you have the rest of the system, which includes the compressor, humidifier and DC-DC converter. That's where the work has gone into adapting this unit for motorsport use."

In practice, Extreme H sits toward the battery-dependent end of the spectrum. With a 75-kW fuel cell supporting a 36 kWh battery, cars will be charged in the paddock before the start of each heat to maximise range. Once on track, the fuel cell then sustains the battery, ensuring consistent output until the chequered flag.

Equally significant is the refuelling setup, designed in partnership with ENOWA. Cars are replenished from a mobile hydrogen station that can be deployed in remote locations – a crucial testbed for the kind of infrastructure commercial fleets will one day rely on. Hydrogen is delivered to site in gaseous form, compressed to between 350 and 700 bar, and stored in carbon-composite tanks. Refuelling is handled by a sealed nozzle, similar to a CNG truck, taking only three to five minutes per car – far quicker than ultra-rapid charging a battery-only vehicle at similar energy levels. Because fast gas transfer generates heat, pre-cooling is integrated into the system to keep fills safe and repeatable.

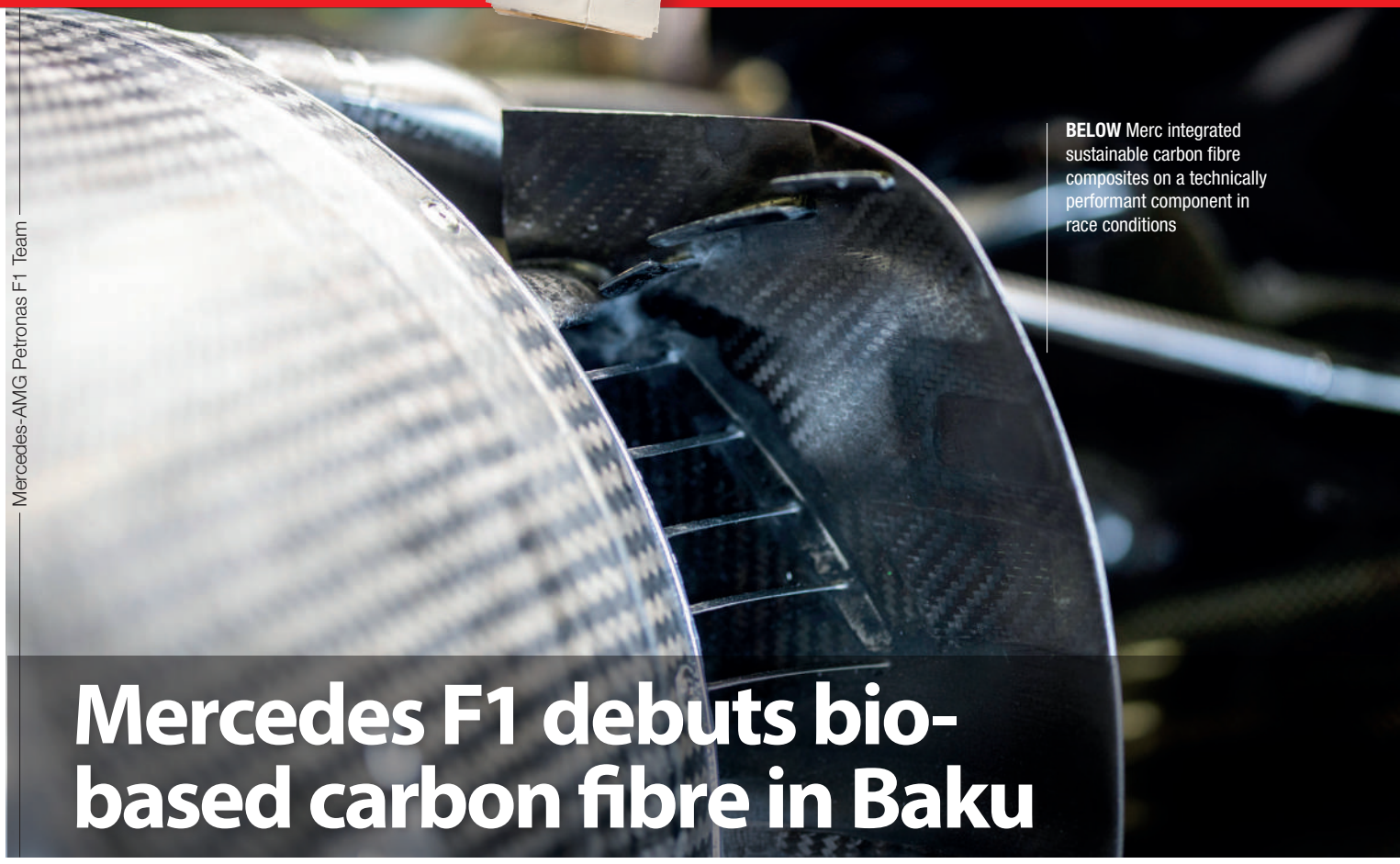
Onboard, the Pioneer 25 carries its own high-pressure tanks that feed the fuel cell stacks. The stacks, in turn, provide a steady electrical flow to the battery, which then delivers the race-winning bursts of power.

Final fling

Before hydrogen takes over, Qiddiya will host a farewell. The Desert X Prix will mark the final outing for Extreme E, the all-electric predecessor to Extreme H. Agag called it "a fitting conclusion for Extreme E, celebrating everything it achieved before we officially make the transition to hydrogen."

Every part of the new event – from cars and refuelling stations to paddock power and broadcast units – will be hydrogen-fuelled, underlining the totality of the shift. By demanding relevance from Symbio's stacks, proving mobile refuelling in the field, and choosing a host nation intent on rebranding itself as a green energy leader, Extreme H becomes more than a race.

When the first hydrogen-powered Pioneer 25s launch across the Tuwaiq desert floor, motorsport will enter a new chapter – one that has been in the making for decades. RT


Mercedes-AMG Petronas F1 Team

BELOW Merc integrated sustainable carbon fibre composites on a technically performant component in race conditions

Mercedes F1 debuts bio-based carbon fibre in Baku

CARBON fibre has long been central to Formula 1 performance, but its petroleum-based origins present a challenge as the sport pursues ambitious sustainability targets. Progress toward renewable alternatives has been gradual, yet this season Mercedes-AMG Petronas F1 Team has taken a significant step by debuting a bio-based composite during the Azerbaijan Grand Prix.

The W16 ran with new rear brake duct wheel shields manufactured using a resin system that replaces 30% of its traditional petroleum-derived content with renewable feedstocks. Developed in collaboration with composites supplier Syensqo, the material marks the team's first use of a sustainable carbon fibre composite on a performance-critical race component.

Brake duct shields are a particularly demanding application given their complex aerodynamic design, exposure to high thermal loads and vulnerability to debris. Demonstrating that the new resin can withstand race conditions provides important validation for the technology's potential within motorsport and beyond.

Toto Wolff, Mercedes Team Principal and CEO, said: "In an era where innovation drives performance and shapes industry futures, the pursuit of smarter, faster, and more efficient technologies has become a defining challenge of our time. This project not only reflects our commitment to sustainability but also highlights the role of Formula 1 as a test bed for pioneering technologies that can benefit a range of industries.

"Our sport is the world's fastest test lab, and these innovations represent our relentless pursuit of performance and appetite to contribute beyond the grid."

Alice Ashpitel, the team's Head of Sustainability, emphasised that integrating bio-based resin represents "a new benchmark for the future of motorsport and beyond."

By weight, approximately 60% of the composite material is formed of fibres, with 40% made up by the resin system that holds them together. Impregnating the fibres with the resin system, followed by curing, creates a lightweight material with outstanding mechanical performance necessary to meet the unforgiving demands of F1.

For a sport that once defined itself by mastery of carbon fibre, Formula 1 finds itself in an awkward position. The very material that transformed performance in the 1980s and '90s now sits uneasily in an era of sustainability, where petroleum-derived resins clash with the sport's net-zero ambitions. Progress toward renewable alternatives has been painfully slow – but as Mercedes-AMG Petronas F1 Team showed in Baku, the journey has at least begun.

As an established leader in composites for automotive applications, Syensqo has been developing novel and efficient solutions for motorsport OEMs for nearly four decades. "Our bio-based resin technology represents a significant step forward in sustainable materials innovation," suggested Rodrigo Elizondo, President, Syensqo Composite Materials.

"By replacing traditional petroleum-based components with those derived from renewable sources, we are not only introducing circularity in our product design but also paving the way for future innovations.

"We are very pleased to see this material applied in such a high-performing environment, showcasing its potential for broader applications."

Mercedes has already trialled sustainable aviation fuels and HVO100 biofuels across its European operations. The addition of bio-based carbon fibre technology reflects the team's wider commitment to achieving net-zero emissions by 2040, while offering a path for composites to evolve in line with the sport's sustainability agenda. RT

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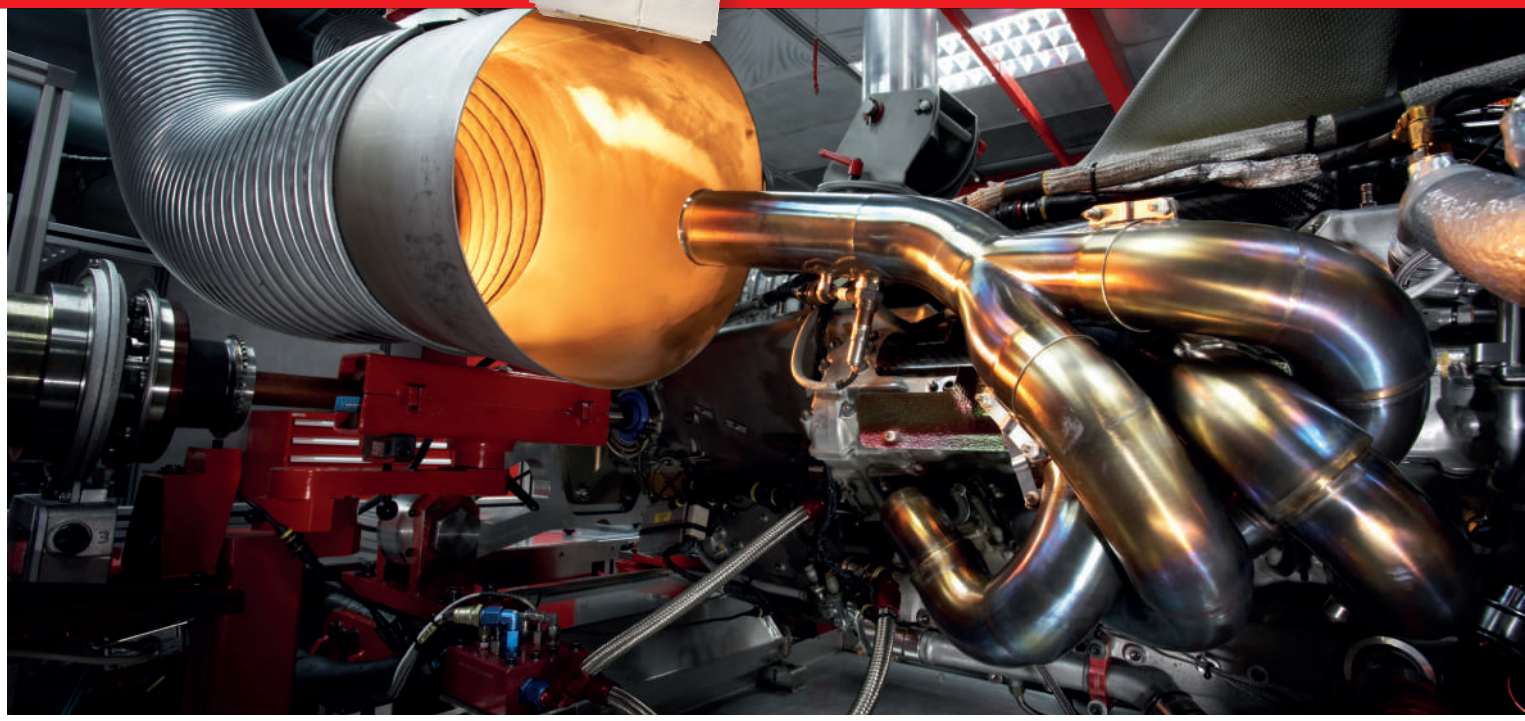

V8 engine push stalls amid manufacturer opposition

ABOVE V8s could still offer a solution, albeit a controversial one

FIA president Mohammed Ben Sulayem's proposal to bring back 2.4-litre V8 engines into Formula 1 from 2029 has been shelved after failing to win the necessary backing from the sport's engine manufacturers.

The plan was tabled as an alternative to the new generation of 1.6-litre turbo-hybrids due for 2026, which will run on 100% sustainable fuel and feature significantly uprated hybrid systems. Those regulations were designed to last until the end of 2030, but Ben Sulayem argued that the package risked being too costly and too complex. His idea was to revert to a high-revving, naturally aspirated V8 with a simplified energy recovery system, powered by sustainable fuel, and paired with a gradual reduction in the power unit cost cap of up to 30% per year.

A London summit of manufacturers had been scheduled for last month, but on the eve of the Italian Grand Prix it was abruptly cancelled once it became clear consensus could not be reached.

At the heart of the debate was not whether to pursue a hybridised V8 concept – which most agreed had appeal – but how to configure it and when to introduce it. Technical discussions focused on the hybrid contribution: some manufacturers favoured as little as 10% of total output from electrical systems, while others argued for closer to 30%. The question of whether a turbo element should be retained was also left unresolved.

Timing proved the biggest obstacle. Ben Sulayem wanted 2029, giving just three years of the new 2026 power units before a reset. Red Bull and Cadillac supported this approach, seeing a chance to control costs and avoid heavy parallel development. Mercedes and Ferrari, however, felt 2030 was more realistic, while Honda and Audi opposed any change before 2031. Under F1's Power Unit Governance Agreement, a "super-majority" is required for such a fundamental change, and with Audi and Honda resisting and Ferrari and Mercedes cautious, the 2029 proposal was doomed.

Mercedes team principal Toto Wolff underlined the manufacturers' position: "Most of the OEMs say we don't want to run a dual cost programme," he said. "It would effectively mean developing a new engine in two years. We didn't want that too."

The financial climate was another factor. Global headwinds – from slowing Chinese growth to fluctuating EV policies in Europe and the US – have squeezed OEM budgets, leaving little appetite for overlapping projects. Manufacturers were also wary of repeating what some already see as flaws in the 2026 rules, where chassis compromises have been made to offset limited hybrid deployment. Rushing another formula risked compounding those issues.

Despite the collapse of the 2029 plan, the V8 hybrid concept itself is far from dead. The consensus remains that a naturally aspirated engine, blended with sustainable fuel and a performance-differentiating hybrid system, could deliver spectacle while reinforcing F1's technical credibility. "The V8, at the end, was the best consensus," Wolff said. "Now it's about dialogue with Mohammed Ben Sulayem and with [F1 CEO] Stefano Domenicali. There's alignment of interest – but more time is needed."

Attention now shifts to 2031, when the current governance cycle expires and new rules can be framed without requiring manufacturer super-majority. By then, sustainable fuels will have matured, hybrid efficiency will have improved, and the sport will be able to consider weight, power-to-weight ratio, and cost structure in a holistic package.

For now, F1 remains committed to the 2026–2030 turbo-hybrid era. Whether the V8 makes a comeback in 2031 depends on whether it can genuinely strike the balance between cost, sustainability, and engineering innovation that the sport demands. RT

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Lancia developing Ypsilon Rally2 HF Integrale

LANCIA'S return to top-flight rallying moved closer last month when it confirmed it is developing a Rally2 car, unveiling images and a teaser video of the new Ypsilon Rally2 HF Integrale. The announcement followed footage that surfaced of the car undergoing asphalt testing in France.

The move represents another step in the marque's gradual return to international rallying. Earlier this year, Lancia re-entered competition with the front-wheel drive Ypsilon Rally4 HF, campaigned in the European Rally Championship and within a new one-make Lancia Rally Trophy. The Rally2 project, however, carries greater historical resonance.

Lancia remains the most successful manufacturer in World Rally Championship history, with 10 constructors' titles between 1974 and 1992. From the Stratos to the 037 and the all-conquering Delta Integrale, the brand's innovations defined rallying's Group 4, Group B and Group A eras. The "Integrale" name alone evokes an era of dominance in which the Italian marque claimed six consecutive titles from 1987 to 1992 – a record still unmatched.

Now, with the Ypsilon Rally2 HF Integrale, Lancia is drawing directly on that heritage. Its launch statement declared: "The new Lancia Ypsilon Rally2 HF Integrale makes its debut, bringing the legendary spirit of Lancia's rally victories into today's motorsport. And this is just the beginning."

Although technical specifications have yet to be released, the car seen in testing is understood to be running with the proven underpinnings of the Citroën C3 Rally2 – logical given that both brands sit within the Stellantis Group. Homologation is expected in 2026, aligning with the World Rally Championship's upcoming regulatory overhaul in 2027. Under that framework, Rally2-based cars will run alongside cost-capped WRC27 machines, potentially opening the door for a full-fledged Lancia comeback at the sport's top level.

After more than three decades away, the Lancia name is once again poised to shape rallying's future. RT

BELOW Spy shots captured during testing forced Lancia's hand

FIA sets new safety benchmark for cross-country rallying

THE FIA has issued the first edition of its Cross-Country Rally Safety Guidelines, creating a unified global framework for an arena long regarded as one of the toughest in motorsport.

Rally-raid combines huge distances, harsh terrain and mixed grids of factory and privateer entries – challenges that demand bespoke solutions. The new guidelines cover course layout, medical intervention, vehicle recovery and tracking, but their most significant sections focus on competitor protection within next-generation alternative-energy vehicles.

Hydrogen, hybrid and EV prototypes are already established in the discipline, from Audi's RS Q e-tron at Dakar to hydrogen categories under development by the Mission 100 initiative. The FIA's new protocols mandate high-voltage isolation monitoring, automatic shut-off switches, and reinforced fire suppression for battery-electric systems. For hydrogen vehicles, rally organisers must now provide on-site leak detection, venting zones and tank protection designed to withstand multi-roll crashes.

FIA President Mohammed Ben Sulayem said: "Cross-country rallying is one of the most demanding forms of motorsport, and its very nature requires us to go further in protecting our competitors and officials. These guidelines provide organisers with the tools to implement the highest possible safety standards, regardless of geography or scale."

The document also references enhanced cockpit integrity testing, with crash structures validated to absorb rollover and side-pole impacts typical of rally-raid. Energy storage systems must be mounted within defined survival cells, while recovery crews will receive new training in handling damaged hydrogen and high-voltage cars.

FIA Cross-Country Rally Commission President Jutta Kleinschmidt stressed the importance of this shift: "With new technologies entering rally-raid, from hydrogen to electric, safety must evolve alongside innovation. This document is the first step toward a consistent, global approach to risk management."

Organisers are encouraged to begin implementation from 2026, with annual revisions to reflect rapid advances in vehicle technology. RT

LEFT The guidelines reflect the rise of alternative powertrains in rally-raid

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Motul returns to F1 with McLaren

McLAREN Racing has confirmed a new technical partnership with Motul, which will join the McLaren Formula 1 Team as an Official Supplier from the 2026 season. The French company will provide high-performance transmission lubricants developed to meet the extreme demands of modern Grand Prix racing.

The deal marks Motul's first involvement in Formula 1 since the 1970s. In the years since, the company has become synonymous with success across world motorsport, supplying teams in the FIA World Endurance Championship, including the 24 Hours of Le Mans, MotoGP, Super GT, and the Dakar Rally. Its products have been proven in conditions ranging from the high-load, high-temperature environments of endurance racing to the dust, heat and vibration of rally-raid.

Transmission fluids play a crucial role in F1 performance. They must reduce friction and wear while managing extreme thermal cycles, withstand high shear forces, and cope with the hybrid stresses introduced by energy recovery systems. By delivering efficiency gains at a microscopic level, Motul's formulations will directly support McLaren in extracting maximum performance and durability from its chassis and power unit packages.

The partnership also aligns with Formula 1's move towards new hybrid power units and 100% sustainable fuels from 2026. Motul has already invested in the development of bio-based and hybrid-compatible lubricants designed to reduce environmental impact without sacrificing performance. Its ongoing work in electric racing, sustainable fuels, and hydrogen programmes further underlines its relevance to F1's technical and sustainability roadmap.

Nick Martin, Co-Chief Commercial Officer of McLaren Racing, said: "Motul has a proud history of innovation and technical excellence, attributes that closely mirror our own legacy. We look forward to working together in this exciting partnership."

Andreea Culcea, Chief Brand and Communications Officer at Motul, added: "This partnership with McLaren marks Motul's return to Formula 1, a discipline where we have written some of the most exhilarating moments of our history. This is a great opportunity to combine both of our expertise in the pursuit of performance and innovation. We are particularly proud that our fluids contribute to the outstanding performance of one of the most prestigious racing teams in the world." RT

LEFT Motul joins McLaren for the 2026 rules reset

FIA University strengthens sustainability expertise

THE Fédération Internationale de l'Automobile (FIA) has appointed Dr Madeleine Orr as Visiting Professor at FIA University. It is hoped her data-led approach and specialist expertise in climate action will drive sustainable progress across motorsport and the wider automotive ecosystem.

She brings interdisciplinary expertise, with a PhD in Kinesiology (emphasis in Sport Management), Master's degrees in both Natural Resource Science and International Event Management, and a strong record of published research and industry engagement. She has been recognised by the Forbes 30 Under 30 and Corporate Knights 30 Under 30 – the latter focusing on young leaders driving sustainable innovation – and other international organisations for her contributions to sustainability and sport.

Her recently published book, 'WARMING UP', examines how climate change is impacting sport, and how the sports world can fight back.

ABOVE Orr says sport can drive innovation

Dr Orr commented: "Sport is not only a powerful platform for entertainment – it's a cultural force that can drive innovative solutions for complex challenges, including climate change."

Two initial projects she is working on are focused on the climate impact to the World Rally Championship, and examining how to reduce emissions related to race calendars.

The FIA University is the global leader in the accreditation, education and research of world motorsport and mobility. Its cutting-edge research informs public policy and strategy across sport and automotive industries, and serves as a vital resource for FIA Member Clubs around the world. It is supported by the FIA Foundation, the independent charitable arm of the FIA.

In 2024, over 250 participants, including Race Directors, Stewards and senior executives, graduated in specialist training programmes spanning sport governance through to advanced leadership. RT

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Ram's NASCAR comeback: "We're doing it big"

"**WE'RE** not going to kind of silently come in or just kind of tiptoe our way in. We're doing it big."

Kaulig Racing owner Matt Kaulig left little doubt about the scale of ambition behind Ram's NASCAR comeback. Partnering with Stellantis, Kaulig will field up to five Ram 1500 entries in the Craftsman Truck Series starting at Daytona 2026 – the brand's first factory-backed effort since 2012.

"This partnership represents far more than a new chapter in Kaulig Racing's history, it's a union of shared values," said Kaulig. "Over the past decade, our team has built a legacy rooted in performance, integrity and giving back to the community. To now join forces as the anchor team for Ram's return to NASCAR is both an honour and a responsibility. Together, we're ready to set a new standard on race day and in the impact we make off the track."

The programme represents the largest single-team commitment in the modern Truck Series and is being positioned not as a tentative step, but as a foundation for something far greater. "With five trucks, there's nowhere to hide," admitted team president Chris Rice. "We'll need to get everything right – engineering, execution, and people – from day one."

For Ram, the Truck Series provides the ideal proving ground. Its controlled technical environment – spec chassis, common aero templates and limited scope for in-race development – keeps budgets manageable while still offering a platform to demonstrate engineering credibility in powertrain and bodywork.

Ram CEO Tim Kuniskis underlined the longer-term vision: "The Truck Series is the right platform to relaunch Ram in NASCAR, but our ambitions are bigger. Kaulig Racing shares our performance culture and appetite to compete.

"We needed a partner that truly aligns with the Ram brand and embraces our unconventional approach to NASCAR," he added. "With Kaulig Racing, we found the perfect synergy to drive our 'Last Tenth' culture forward."

Kaulig Racing currently fields two chartered entries in the NASCAR Cup Series and three teams in the NASCAR Xfinity Series, scoring 29 race wins over the last seven seasons across the two series.

From a technical perspective, the challenge is far from trivial. Ram will need to homologate a race-ready version of the Ram 1500 body shell and develop a competitive V8 engine package under NASCAR's tightly regulated formula. Supplier integration will be crucial, from machining partners to electronics specialists, while Kaulig's operation will need significant expansion in data acquisition, aero testing, and reliability engineering to support the five-truck fleet.

The ramifications stretch to the Cup Series. By investing heavily in infrastructure now, Ram and Stellantis could accelerate the timeline for a Next Gen entry, positioning themselves to challenge Toyota, Ford, and Chevrolet. Industry insiders view the 2026 Truck campaign as both a technical dress rehearsal and a statement of intent: if Ram can win with scale in Trucks, it will have the engineering base – and the political leverage – to return to NASCAR's top tier. RT

BELOW Kaulig Racing has been named the anchor team for Ram's return to NASCAR

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Aston Martin to integrate Pirelli's Cyber Tyre into vehicle dynamics architecture

ASTON Martin will become the first OEM to integrate Pirelli's Cyber Tyre system into future production models, marking a significant step in tyre-borne data acquisition and control integration.

Developed exclusively by Pirelli and benefiting from a collaboration with Bosch Engineering, Cyber Tyre embeds sensors inside the tyre carcass, positioned beneath the tread. These capture key operating parameters – including temperature, pressure, load and contact patch status – and transmit them to an electronic control unit. Pirelli's proprietary algorithms process the data in real time, enabling direct communication with chassis and powertrain systems.

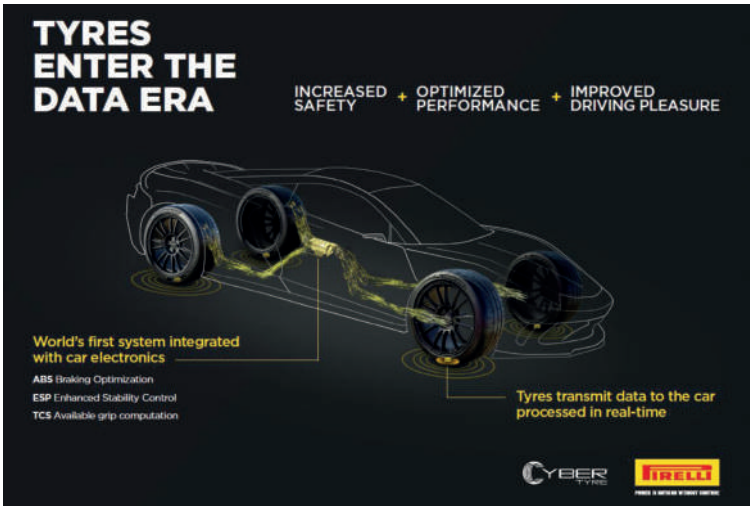
The result is a live feedback loop between the tyre and the car's electronic stability programme, ABS and traction control, allowing those systems to operate on a much more precise set of inputs than standard pressure and temperature sensors provide.

"Tyres are the only element of the car in contact with the road surface," said a Pirelli spokesperson. "By embedding intelligence at the contact patch, we deliver a higher-fidelity data set that allows vehicle dynamics systems to respond with far greater resolution."

For Aston Martin, the system represents an opportunity to integrate tyre intelligence into the wider dynamics control architecture. "The capability to merge real-time tyre data with our chassis systems unlocks additional performance and safety margins," said an Aston Martin representative.

While primarily aimed at ultra-high performance road cars, the system has clear motorsport relevance. For track use, Cyber Tyre supports features such as a 'virtual race engineer', optimal temperature windows, and live pressure optimisation. Pirelli has also investigated adapting the technology for Formula 1, though the thermal and load environments remain a challenge.

Nonetheless, the company stresses that motorsport remains a key proving ground. "Track applications allow us to validate algorithms under extreme conditions, accelerating the transfer of intelligence from racing to road," Pirelli added. RT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BELOW Cyber Tyre will be fully integrated within the electronic architecture governing car dynamics

Yokohama named Official Tyre Partner for Extreme H

EXTREME H, the FIA's first hydrogen-powered motorsport series, confirmed The Yokohama Rubber Co Ltd as its Official Tyre Partner ahead of this month's inaugural World Cup round in Saudi Arabia.

The deal sees Yokohama supply a prototype version of its GEOLANDAR X-AT all-terrain tyre, engineered with reinforced durability for the unique demands of hydrogen-powered and electric off-road vehicles. The tyre incorporates 38% renewable and recycled raw materials, underlining both companies' commitment to sustainability.

Ali Russell, Managing Director of Extreme H, said: "As we break new ground in hydrogen motorsport, having a tyre partner with a proven track record of high performance and sustainability is critical. Yokohama's innovation and global reputation make them an ideal collaborator as we push the boundaries of what's possible – both on and off the track."

ABOVE The Extreme H deal reflects Yokohama's tech roadmap

Takayoshi Omae, Associate Officer at Yokohama Rubber, added: "The GEOLANDAR prototype represents both our technical expertise and our commitment to building a more sustainable world through high-performance products."

For Yokohama, the partnership reflects a wider corporate roadmap. Under its medium-term management plan, Yokohama Transformation 2026 (YX2026), the company is aiming to maximise sales of high-value-added tyres while accelerating the use of sustainable raw materials across its flagship ADVAN and GEOLANDAR brands. RT

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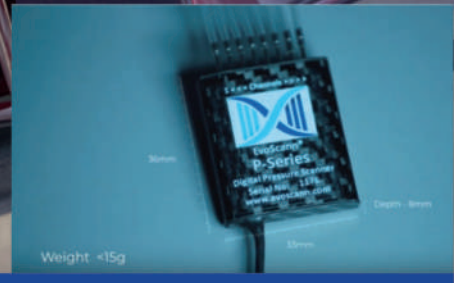

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Rallycross loses World Championship status

THE FIA has confirmed that from 2026 rallycross' top tier will revert to European Championship status, effectively ending the FIA World Rallycross Championship in its current form. A one-off "World Cup" showcase is planned to maintain some global presence, subject to World Motor Sport Council approval.

The move comes after two turbulent years in which the series experimented with electric RX1e cars, suffered a garage fire that curtailed events, and then ran a "Battle of Technologies" format pitting EVs against combustion entries. Despite that, dwindling grid numbers and the collapse of its former promoter forced the FIA to assume direct control earlier this year.

From 2026, the six-round FIA European Rallycross Championship will feature only internal combustion cars, running on sustainable fuels. A new technical rulebook aligned with the World Rally Championship is planned for 2028 to deliver "safer, modern, more affordable, yet faster vehicles," according to the governing body.

FIA Road Sport Director Emilia Abel said the shift is intended to simplify the discipline while rebuilding competitor and fan confidence. "The past two seasons have been a true battle of technologies, with electric and combustion power going head-to-head," she said. "That era showed how rallycross can lead in motorsport innovation, and the lessons learned will remain part of our DNA. The move to an internal combustion drivetrain builds on this foundation, delivering an affordable and accessible format to grow grids and intensify competition."

Abel added that rallycross' European relaunch will be coupled with a global event to preserve international ambitions. "With the European Championship providing a strong racing format, and plans for a World Cup to create a thrilling global showcase, we are offering the best of both worlds as we transition toward the new technical regulations for 2028." RT

ABOVE WRX has been downgraded to European Championship status

MIA CTS25 to showcase next-gen motorsport engineering

THE Motorsport Industry Association's annual engineering and technology show (CTS25) returns to the Silverstone Wing on 15-16 October 2025, promising a high-octane showcase of innovation for the UK's motorsport supply chain.

Organised by the MIA, CTS25 is expected to attract hundreds of delegates, technology providers, OEMs, engineering firms and R&D specialists. The show will occupy Halls 1-3 of the Silverstone Wing, placing exhibitors in proximity to one of motorsport's most iconic venues.

Key themes will include advanced simulation and CFD tools, sustainable materials and propulsion technology, autonomous meshing, and engineering solutions for reliability under the rigorous demands of motorsport. Industry watchers expect to see both incremental improvements in existing systems such as lightweight components, thermal management and aerodynamics, alongside emergent technology that may reshape how teams conceive performance margins.

One exhibitor, Converge CFD, is promoting its Horizon platform and academic outreach as part of the show programme, underlining the importance of simulation and modelling in reducing physical prototyping costs. Free parking, improved access via the hotel-venue bridge and a programme of networking events are among the visitor amenities being promoted.

With automotive trends pushing toward electrification, hybrid systems, and stricter emissions and efficiency regulation, CTS25 represents a chance for suppliers and engineering firms to align with the shifting technical landscape. RT

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- **PDM-4C** incorporates CAN Bus connectivity for transmitting diagnostic data including output status, volts, amps, configuration settings, etc. Outputs can also be controlled through CAN Bus.

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F1 explores broader media partnerships as U.S. rights deal looms

FORMULA 1 is looking to expand its media partnerships beyond traditional broadcasting, with Liberty Media CEO Derek Chang highlighting the sport's "sought-after" position in global rights negotiations.

The U.S. television contract, currently held by ESPN, expires at the end of 2025, with Apple reportedly emerging as a strong contender for the next deal. Speaking at the Goldman Sachs Communacopia & Technology Conference, Chang indicated that the U.S. approach may serve as a blueprint for other key markets.

"Much like the U.S., I think this is a holistic sort of view of traditionally what's been known as your media partner, but I don't know if it's necessarily a media partner per se in a classic sense of someone who's just broadcasting your race. It is someone who can help fans access your content beyond the race. It is someone who can help your fans interact with even your sponsors. It's all of that," Chang said.

The shift reflects F1's strategy to enhance fan engagement through digital platforms, interactive content, and sponsor integration, rather than relying solely on linear TV coverage. Globally, F1 has already secured deals in Brazil with Globo and renewed contracts in Canada, with discussions ongoing in other major territories.

Chang also praised the sport's commercial performance. "There's always an investor narrative that there's a finite period at which something's going to end... As we are filling a lot of categories, there are still several that can be filled. I think there's growth opportunity in terms of existing renewals that are going to happen here over the next several years," he said.

The combination of carefully managed sponsorships, tightening inventory, and long-term brand partnerships is designed to maximize monetization while maintaining fan engagement. Chang concluded that Formula 1's leadership team, led by CEO Stefano Domenicali and Chief Commercial Officer Emily Prazer, is positioning the sport to attract partners "who view this as part of their own playbook" and can help extend F1's reach beyond the race weekend. RT

BELOW F1 is looking beyond traditional broadcasting

RacingSyn launches turnkey engineering alliance

RACINGSYN, a new engineering alliance, has launched to provide agile, end-to-end technical support across motorsport disciplines. The organisation unites a roster of engineers with over 270 years of combined experience, covering rally, rally-raid, endurance, GT racing, and Formula 1.

Founded by Emanuele Battisti – formerly chief designer and project manager at Ralliart, Prodrive, Toyota Gazoo Racing and M-Sport – RacingSyn is designed to act as a plug-and-play partner for manufacturers and teams, enabling rapid scaling of engineering capacity.

"I know firsthand the challenges involved in sourcing the right skills quickly for technically ambitious projects," Battisti explained. "RacingSyn brings together expertise gained across multiple motorsport levels into a single hub of engineering capability."

The new organisation delivers experienced engineers across all major aspects of race car design, development and operation.

By also growing its network with talented freelance engineers, RacingSyn is increasing its capacity to meet customer demand.

From CAD design and Finite Element Analysis, through powertrain development, aerodynamic development and CFD analysis, RacingSyn offers turnkey support to companies large and small from the drawing board stage of a project.

Experts in braking systems and electronic systems mean the organisation offers 360° design and engineering support, from concept to detailed realisation.

ABOVE Emanuele Battisti is the founder

In addition to vehicle development, RacingSyn offers proven motorsport-specific supply chain and procurement experts, as well as project and resource management skills to help keep projects on track and within budget.

When a car hits the track, RacingSyn can quickly expand skill levels by supporting trackside and test engineering.

Through RacingSyn's wide network of engineers, it also plays a role in shaping sustainable motorsport, by supporting the development of electric, hydrogen, and sustainable fuel projects.

The organisation also brings marketing and communications knowledge, ideal for giving start-up projects a strong launch.

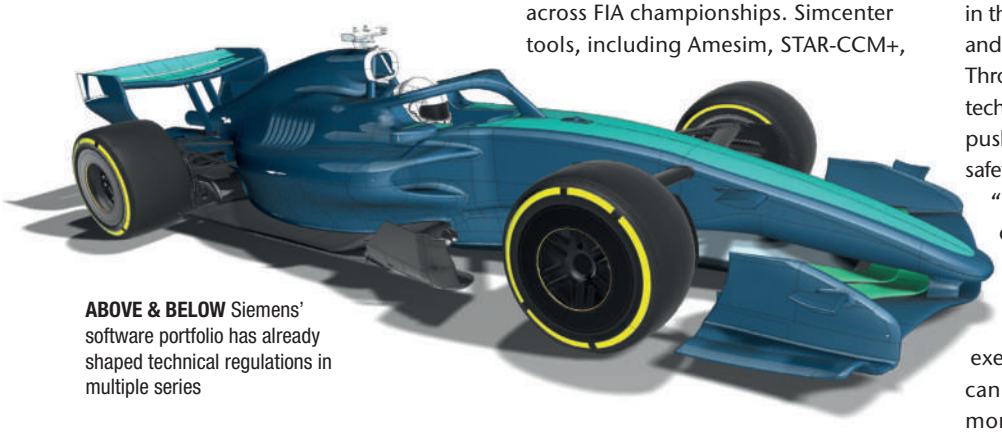
RacingSyn's first projects are already underway. RT

FIA leverages Siemens digital twin to future-proof single-seater regulations

THE FIA has named Siemens Digital Industries Software as its Official Digital Twin Sponsor in a multi-year agreement that blends cutting-edge engineering with the federation's sustainability and performance ambitions.

The collaboration is part of the FIA's recently launched Global Partnership Programme, designed to unite leading organisations committed to advancing innovation, safety, and environmental responsibility in motorsport.

At the heart of the partnership is Siemens' Xcelerator portfolio, including Designcenter NX for CAD modelling, Teamcenter X for product lifecycle management (PLM), and the Simcenter suite for simulation and optimisation. Together, these tools form a fully integrated digital ecosystem, enabling the FIA to create virtual prototypes, test aerodynamic performance, and refine regulations without the need for costly physical models or extensive wind tunnel campaigns.



ABOVE & BELOW Siemens' software portfolio has already shaped technical regulations in multiple series

"Siemens gives us the precision tools to design and test aerodynamic concepts virtually, reducing environmental impact while improving performance and safety," said Jason Somerville, FIA head of aerodynamics. "This technology is key to ensuring racing remains closer, fairer and more competitive – all while supporting our ambition to reach net zero by 2030."

The FIA's aerodynamics team has been using Designcenter NX since 2022, generating over 14,000 CAD components and running more than 10,000 computational fluid dynamics (CFD) simulations. By iterating designs digitally, engineers can explore multiple configurations rapidly, assess airflow, downforce, and drag, and optimise performance within regulatory constraints before committing to physical prototypes. This workflow also enables advanced scenario testing, such as crash aerodynamics and safety-critical airflow, without the environmental footprint of traditional methods.

Teamcenter X complements the process by managing product-related information and enabling collaboration across FIA championships. Simcenter tools, including Amesim, STAR-CCM+, and HEEDS, allow for design exploration, optimisation, and virtual validation of complex vehicle systems. According to the FIA, the digital twin approach has accelerated regulatory development while embedding sustainability principles into technical processes.

Craig Edmondson, FIA chief commercial officer, highlighted the strategic importance: "This collaboration shows the strength of our partner network, where world-class brands are helping us deliver progress across performance, safety and sustainability."

From Siemens' perspective, motorsport serves as a high-tech proving ground. "Motorsport is a living lab for innovation, incubating technological advancements that often transform series production later," said Cedrik Neike, CEO of Digital Industries and Member of the Managing Board of Siemens AG. "But the race starts before the rubber meets the road. It begins in the factories, with advanced software and the minds of brilliant engineers. Through our immersive digital twin technology, we're enabling FIA to further push the boundaries of performance, safety, and sustainability for mobility."

"Siemens Xcelerator is enabling FIA engineers to design, simulate and optimise with greater precision," said Nand Kochhar, VP of automotive and transportation. "This exemplifies how digital transformation can accelerate progress toward a more sustainable and technologically advanced future for mobility."

By combining CFD, PLM, and integrated simulation workflows, the FIA is not only shaping the next generation of single-seater regulations but also demonstrating how digital twin technology can reconcile performance, safety, and sustainability in motorsport. RT

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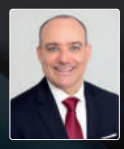
"I really appreciate the effort that goes into the Symposium, the straightforward open discussion, informed debate and reflection."



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ERIC JACUZZI
Vice President, Vehicle Performance at NASCAR

"Another great learning experience for the two of us that attended from NASCAR. The topics were very relevant to the future of motorsport, and challenged us to look deeper into some areas of development that we had not previously considered or perhaps considered seriously enough. As always, the collegial atmosphere and lively debates and conversations make for a great event. I am looking forward to seeing everyone again next year and hearing about the advancements another year brings"

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Nominees and winners will be announced at the World Motorsport Symposium Champagne Drinks Reception and Networking Awards Dinner on the evening of Monday 17 November 2025, to be held at The RAC Club in Pall Mall, in front of key influential global leaders in the motorsport and automotive industry.

FORMULA E IN SAFE HANDS

Chris Pickering talks to the FIA about a steering damper it has been developing to solve the mystery of a sudden series of hand injuries in Formula E's Gen 3 era

AS the saying goes, Motorsport Can Be Dangerous. Every driver acknowledges that when they go out on track. But when a spate of hand injuries began emerging from relatively minor crashes in Formula E, it became clear that something wasn't right.

The problems began with the very first race of the Gen 3 era. Robert Frijns clipped the back of Norman Nato's Nissan in a first lap incident at the 2023 Mexico City E-Prix. The Dutchman was in surgery for five hours to repair a broken wrist and four fractures in his hand. A couple of months later, Sébastien Buemi fractured his hand during the Sao Paulo E-Prix, followed by Sam Bird in free practice at Monaco in 2024.

"I realised we were getting hand fractures that are not normal. I've been a doctor in motorsport for 20 years so I know the drivers very well, and based on the feedback from them, I spoke to the safety department and said that something needed to be done," FIA Formula E World Championship medical delegate Bruno Franceschini explained at the time.

In addition to the broken bones, there were reports of drivers experiencing bruising. It was clear that drivers in the Gen 3 car were abnormally prone to hand injuries, so the FIA safety department set about investigating the cause and developing a solution.

> *"We realised straightaway that the drivers' hands were impacting the cockpit"*

"We realised straightaway that the drivers' hands were impacting the cockpit. But there were several major constraints in addressing this problem as the Formula E car uses a monocoque chassis, which is not easy to reshape," recalls Marco Petrilli, deputy safety director and head of research and vehicle safety at the FIA.

"We tried to put everything on the table, comparing the

RIGHT The FIA has been working hard to understand why Formula E drivers have been suffering hand injuries during crashes in its Gen 3 era

Formula E car with the other single seaters we work with. Clearly, we believed that the absence of power steering on the Gen 3 car was potentially the main contributory factor, but that was another constraint that we couldn't change. It would have been impossible even to test power steering on the Gen 3 car, because it's not a system that you can put in a car in a short time. It would have required a significant rethink, not just in terms of the steering installation but also suspension design."

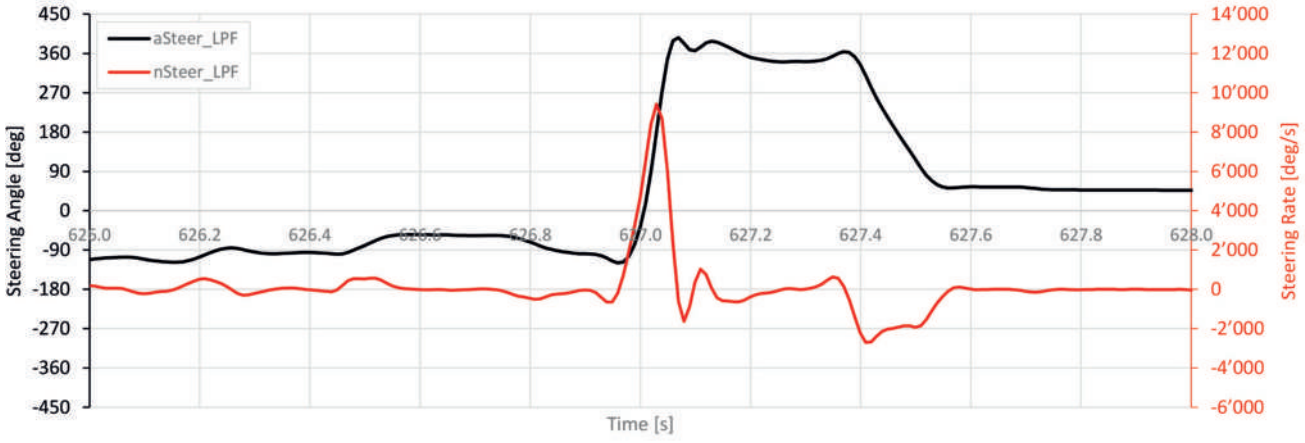
The FIA engineers began putting together a package of measures that could be applied to the existing Formula E car. These included cockpit padding, increased hand clearance measures, new front wing bodywork and revisions to the steering wheel. But the most significant change was the introduction of a dual-rate linear damper that now sits in parallel to the steering rack.

Energy dissipation

Steering dampers are commonly used for off-road applications and motorcycles, but they're a rare sight on single seaters. The concept works much like a suspension damper, with the valving tuned to make the damping effect negligible at normal shaft speeds, while providing significant energy dissipation in the event of a sudden shock through the steering.

Data analysis showed that the peak rotational speeds of the steering wheel in the accidents leading to hand injuries were up to 10 times greater than the drivers would experience during a normal racing lap – typically peaking at approximately 9,000 deg/s, with a pulse duration of around 100 ms. ▶

Getty Images/Formula E



The design and optimisation of the damper was carried out by PKM Consulting, while Formula E chassis manufacturer Spark Racing Technology led the installation and integration. Petrilli and his colleagues at the FIA were mostly focused on defining the requirements for the damper. The final piece in the puzzle came from the FIA Foundation, which provided financial support, as well as independent engineering consultancy to validate the findings of the project.

ABOVE In the majority of the accident cases, the peak rotational speed of the steering wheel is approximately 9,000deg/s, with a pulse duration of ca. 100ms – up to ten times greater than a normal racing lap

BELOW Robin Frijns needed five hours of surgery to repair a broken wrist and four fractures in his hand after this first lap incident at the 2023 Mexico City E-Prix

"The drivers were already reporting that the steering effort of the Gen 3 car was quite significant, so the first constraint was that it needed to be as transparent as possible in normal driving – we didn't want to install something that would increase the effort for the driver," says Alain Beaufrere, senior research engineer leading the project. "Next, we had to define the threshold where the damper would start to work. Clearly, that's based on the rotational speed of the column, so we had to define a point that was high enough to avoid interference in normal driving, but low enough to ensure that it

Formula E

would activate during an impact."

A variety of active and passive, electric and hydraulic systems were considered, before the team homed in on a passive hydraulic damper. This is mounted on the front anti-intrusion panel, placed parallel to the steering rack, with the valving system contained in a separate chamber.

"Integrating the damper wasn't an easy task, because it sits in between the chassis and the frontal impact structure," comments Petrilli. "This required modifications to the frontal impact structure, as well as a bit of modification to the anti-intrusion panel. On top of that, the bracket that connects the steering rod to the rack has been completely redesigned to connect the damper. Changing multiple parts on a car that was intended to stay the same for its entire lifecycle wasn't something we did lightly."

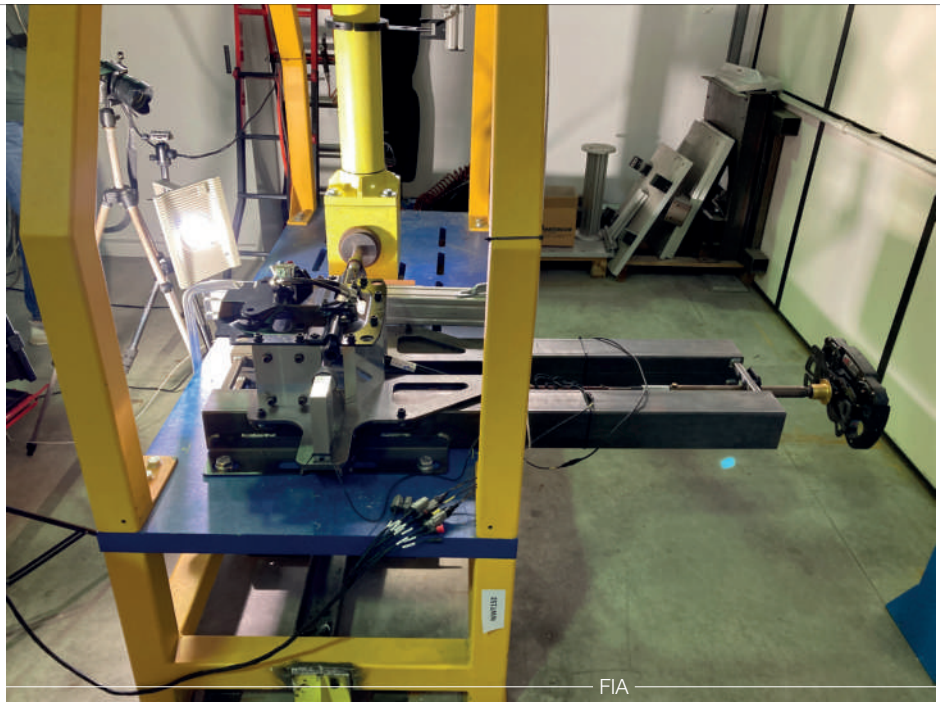
> *"Steering dampers are common in off-road applications but a rare sight on single-seaters"*

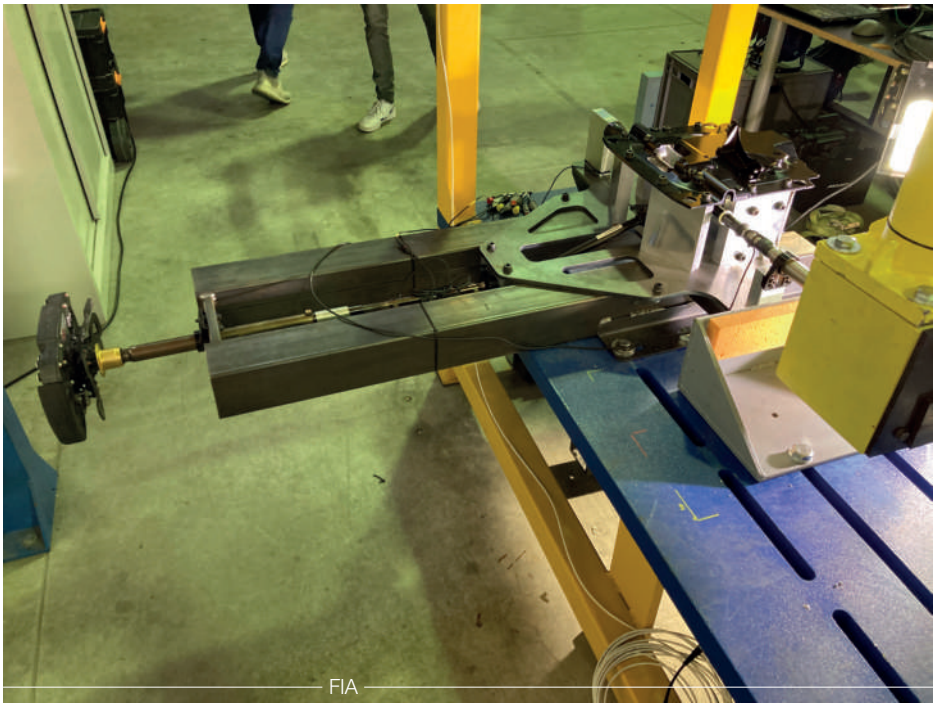
FIA safety director Nuno Costa adds that one of the most important considerations was to carry out all these modifications without impacting the rest of the car's functionality: "We had to look at a lot of different use cases to ensure that what we were doing with the damper wouldn't have downsides elsewhere. The car had already been homologated and put through safety testing, so we needed to be sure that it would still deliver that performance."

The FIA worked with Spark to verify that the installation of the damper wouldn't affect the strength of the nose or the performance of the impact structure. Another consideration was the small weight increase it brings to the cars, which was signed off in consultation with the teams after the system had been shown to work.

Test process

The first prototype was built with a 'force adjuster' that could alter the rotational speed threshold and a 'blow-off adjuster' that controlled the degree of damping available. Both were evaluated during lab testing and track testing with the teams before the finished dampers were manufactured as non-adjustable items.

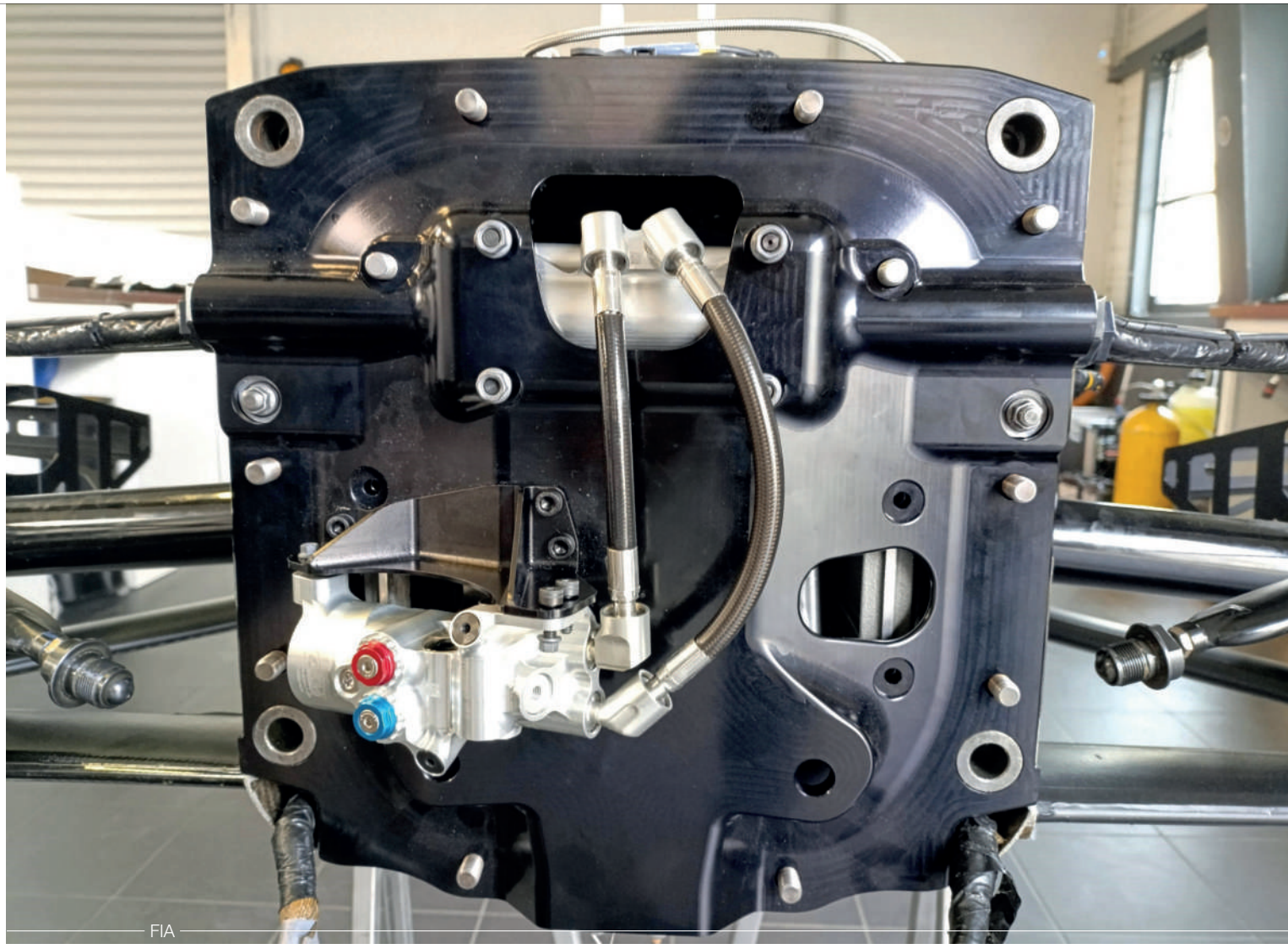

FIA


FIA

ABOVE & TOP The FIA organised a laboratory test at Newton Srl to assess the impact performance. For this Spark prepared a specific installation of the steering system onto the rig. A dummy steering rod with an impact surface was connected to the steering rack and the impact was done by means of a pendulum mass

The race data showed that the wheel experienced rotational speeds of up to around 1,000 deg/s in normal driving. Eventually, the force adjuster was set to its lowest value – corresponding to just over 1,600 deg/s – as this was comfortably above the normal operating range, but well below the figures typically seen in accidents that led to injury. The blow-off adjuster, meanwhile was set to its highest level, which corresponds to a damping effect of up to 5 Nm/rad s-1.

The first priority was to ensure that the damper system would integrate successfully into the chassis, so the test programme began with an installation check, followed by private track tests and pre-season testing at Jarama. Here, the main aim was to ▶



FIA

prove that the damper would not be intrusive during normal driving. While some teams mastered the installation of the system straight away, others are said to have required more support from Spark to nail down a satisfactory installation. In some cases, it was shown that a suboptimal installation could lead to increased steering effort at certain angles. With guidance from Spark and an updated installation procedure, all teams were reportedly able to find an installation that was unobtrusive in normal driving.

> *"We had to ensure that what we did with the damper wouldn't have downsides elsewhere"*

After the concept had been proven, attention shifted to a series of laboratory tests at Newton SrL near Milan, where impacts were simulated using a dummy steering rod impacted by a pendulum. Initial calibration tests were carried out at low speeds without the damper to understand the system's response. Next, the team had to find the impact speed that would result in the reference rotational speed of 9,000 deg/s. Several baseline tests were carried out without the damper to establish repeatability, followed by a series of tests with the damper in place. These were shown to deliver a reduction in the peak rotational speed of the wheel of up to 40 per cent.

Armed with this experimental data, the damper was equipped on all cars from the start of Season 11. Since then, there have been no hand injuries recorded in the ▶

ABOVE The damper shaft and body are installed parallel to the steering rack, while the valving system is externalized into a separate chamber. The installation takes advantage of the Front Anti Intrusion Panel (FAIP)

BELOW Sam Bird suffered a hand fracture after going off at Ste Devote during free practice at Monaco in 2024

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category, Costa explains: "We can't say categorically whether or not the steering damper has prevented any injuries – that would be speculating – but there have been incidents in the past season where we've monitored the data and we've been able to see the steering damper working. The rotation of the steering [in an impact] is much, much slower than we have seen previously."

What makes this project so interesting is that it was a response to a very specific issue that has so far only been seen in Formula E. When the Gen 4 car debuts next year ahead of Season 13 it will come with a raft of changes, including the adoption of power steering, which may well eliminate the need for a steering damper.

> *"The rotation of the steering in an impact is now much, much slower"*

No other category has highlighted a direct requirement for a steering damper so far, although Petrilli points out that the expertise gained in this project could be used to develop a similar system for other applications, if it was required. He notes that

BELOW & BELOW RIGHT The Formula E season that concluded in 2025 featured a number of crashes but didn't lead to any hand injuries, suggesting success for the FIA steering damper

LAT Images/Formula E

rally raid events are one area that they'll be keeping an eye on as kickback through the steering on rough surfaces could potentially represent a safety issue if it led to a loss of control, even if there wasn't a direct problem with hand injuries.

"It's not something that we see a need to pursue at the moment, but now the knowledge is there it could be applied to other categories," comments Costa. "That would require a complete redesign of the system – it's certainly not a plug and play situation – but we're happy to work with manufacturers, promoters and other sanctioning bodies if they needed something like this."

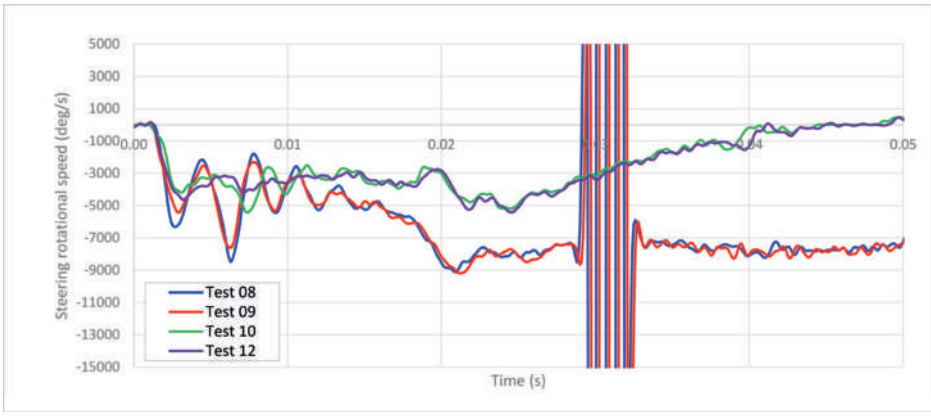
He points to the development of the steering damper as an example of the collaborative approach that the FIA endeavours to apply: "We like to be data driven. Everything was initiated based on the medical data that we have in place. Bruno Franceschini started analysing the injuries and making reports. Then there was a big collaboration with different partners – getting telemetry, analysing data from coming from the teams, onboard camera footage from the promoters. From there, it was very much a scientific approach. First we try to understand the problem, and then we try to find a solution."

Based on the injury-free season that concluded earlier this year, they appear to have succeeded.

Damper	Without		With	
Test #	Test 08	Test 09	Test 10	Test 12
Impact speed	[missing]	2.38 m/s	2.41 m/s	2.36 m/s
Steering angle delta	720 deg	720 deg	123 deg	127 deg
Peak steering rotational speed	9'217 deg/s	9'319 deg/s	5'572 deg/s	5'480 deg/s

ABOVE & BELOW The FIA carried out repeatability tests with the steering damper fitted. They showed the steering damper proved to reduce the peak rotational speed of the steering wheel by up to 40 per cent

40% peak reduction



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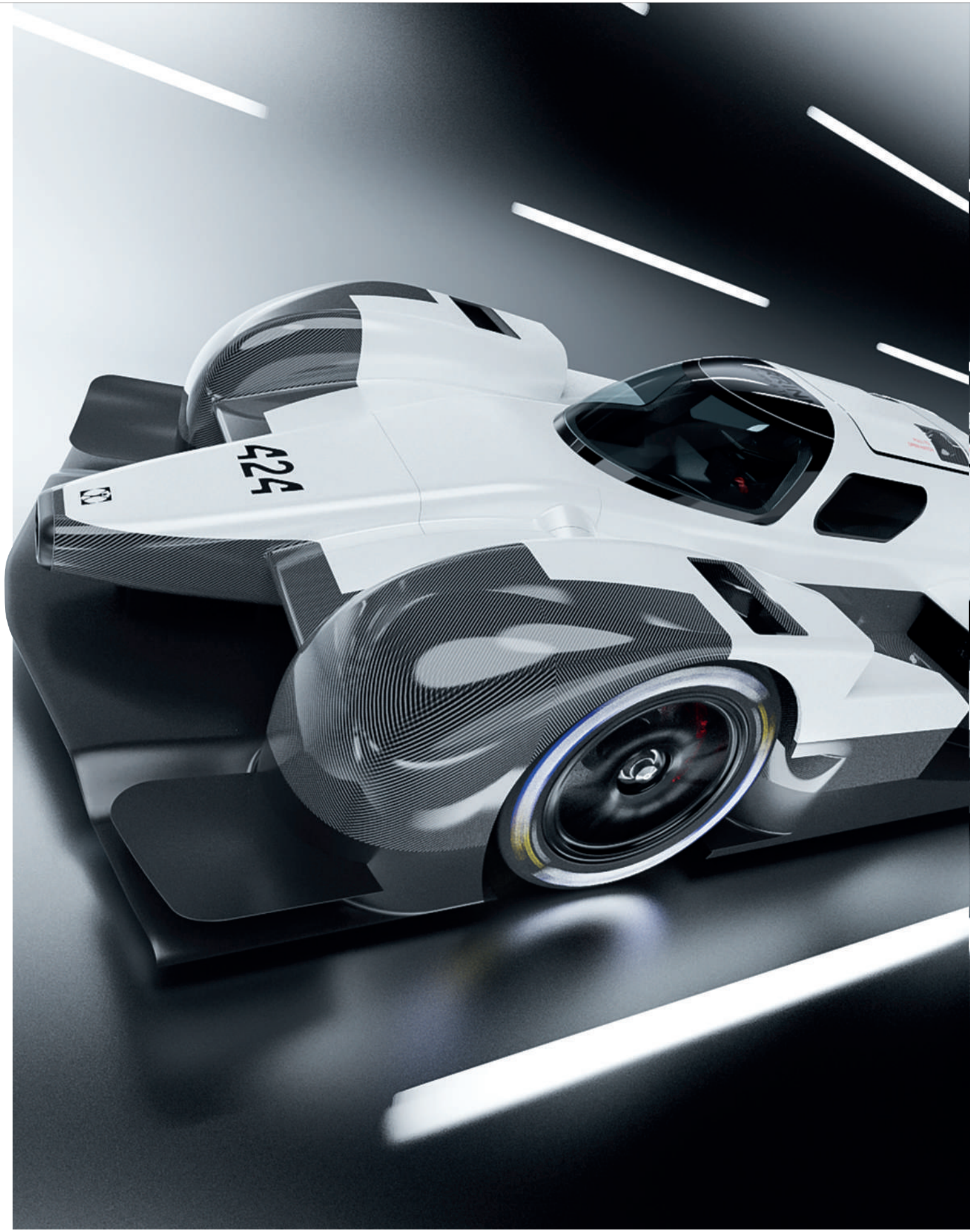

424

ABOVE The all-electric Perrinn 424 BEV is preparing for an assault on the Nürburgring's legendary Nordschleife

ENGINEERING THE FUTURE

Chris Pickering meets Nico Perrin, a visionary engineer with ambitions to take on – and dominate – the world's classic circuits using novel hydrogen and electric technology

NICO Perrin is a man with a vision. The former F1, LMP1 and Formula E engineer wants to win Le Mans. And he wants to do it with a hydrogen fuel cell powertrain.

Not only that, but he wants to do it in a team with his own name over the door. It's an incredibly ambitious plan, but one that's rooted in first-hand experience of what a small team can accomplish with the right structure.

His company, Perrinn 424 (the name is spelt with an extra 'n' for commercial reasons) is perhaps best known for developing an LMP1 prototype with a unique open-source approach. The organisation planned to share everything from CAD data to radio traffic publicly to provide an extra level of involvement for fans and sponsors. Just as radical was the plan to 'decentralise' the team structure, with personnel spread all over the world.

A full-size model was built, and extensive digital testing was carried out, but the car never actually made it to the track. Now Perrin is back, taking his novel vision a step further and hoping to capture the greatest prize in sports car racing.

First, however, he plans to break the Nürburgring lap record for an all-electric car. On the face of it, that's another lofty ambition, but Perrin is well qualified to take on the challenge. In between stints at Williams F1 and Jaguar Formula E, he worked as the chief aerodynamicist and race engineer for NIO's Nürburgring record campaign. This saw the Chinese brand team up with RML to smash the lap record for electric cars on the Nordschleife in 2016 before claiming the outright record for production cars in 2017 (albeit on track-only slick tyres).

"The main thing I learnt from the experience with NIO was that there is a place for a small group of experts to help big companies achieve their goals. NIO was only a start up at the time, but it had a lot of investment behind it. They wanted to make a big splash to launch their brand and that's what we provided," he comments.

"On a personal level, it came after we'd tried really hard to sell the LMP1 car and it hadn't quite happened. That can knock your confidence a bit, but the NIO project went really well. I remember thinking: 'I can really do this'."

Back to the future

Perrin was a successful kart racer as a teenager. He began his engineering career working for Courage Competition in the early days of the LMP1 category and fell in love with endurance racing.

"I absolutely loved working at Le Mans... it's the best race in the world," he says. "I left because I'd always wanted to do Formula 1, but I thought: 'I'll come back with my own car one day, and I'll win this race'. We're talking 20 years ago, and since then every single step of my career has been towards that."

A successful track record across F1, sports cars and Formula E could have opened up a route into team management, but Perrin says he's always stuck with engineering to gain experience of a wide range of different technical aspects. Over the years, ▶

Nick Dungan/Beadyeye

LEFT Perrin puts such verve and energy into his grand visions he can't help but inspire the teams around him to share his dreams

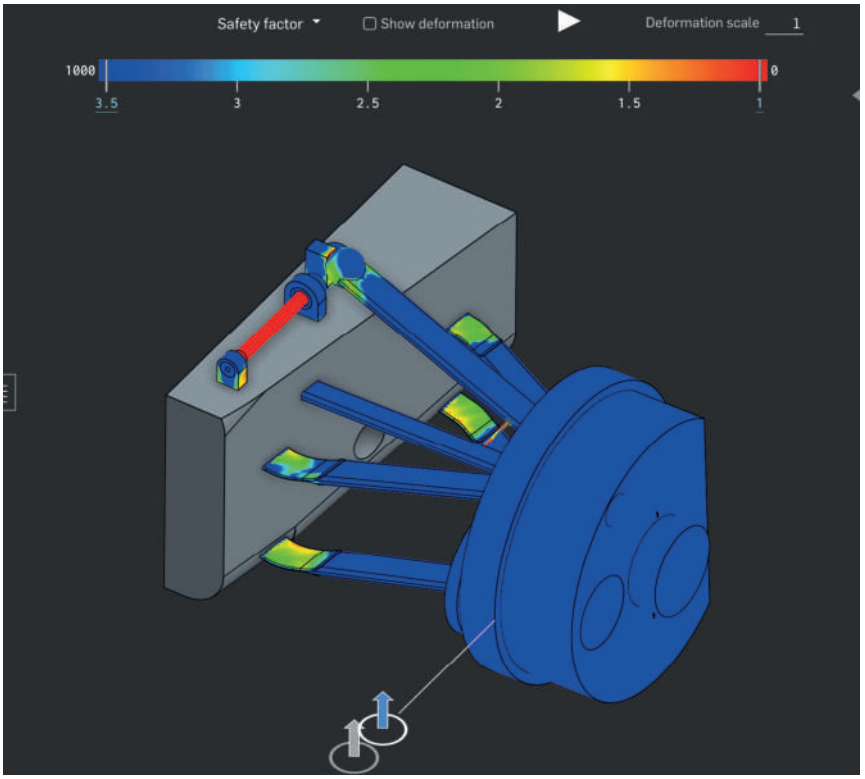
he's gone from being a race engineer with Courage to an aerodynamicist at Williams and NIO, then on to mechanical and electrical design with Jaguar. All with that aim of returning to Le Mans.

So, why the goal of using a fuel cell – especially when a number of high-profile manufacturers seem to be veering towards hydrogen combustion instead?

"The main reason I favour an electrically-driven car is simply performance," he insists. "It might not be there yet, but the potential is huge. Electric propulsion beats ICE on so many levels – in terms of simplicity and the ability to provide four-wheel drive."

Perrin says he's a firm believer that all racing cars will go four-wheel drive at some point: "Four-wheel drive is incredibly powerful from a vehicle dynamics perspective, but it's very hard to exploit that with a conventional ICE engine and transmission. With multiple electric motors, it's much easier to manage the torque split from front to rear.

"Taking the gearshifts away is also a massive thing when you drive a car at that level. You can have all sorts of discontinuities and problems with the wheels



RIGHT Suspension bridge: one of the key reasons Perrin favours electric power over ICE is its ability to make the most of four-wheel drive

BELOW Perrin has previous at the Nordschleife, having worked as chief aerodynamicist and race engineer for NIO's record-breaking electric run in 2016

locking up if you have to brake and change gear at the same time in an ICE car. I drive the 424 BEV a lot in simulation and it's like going back to the purity of karting, but multiplied by 10. It's got so many good attributes from a performance point of view, we just need to solve the energy storage issue. And that's coming."

Electric dreams

For Perrin, the key focus is electrification, with hydrogen being an enabler rather than the other way around. That's why he sees a battery electric record breaker as the logical step to Le Mans.

Much of the design work for the all-electric 424 BEV has already been completed. This has enabled the company to begin virtual testing, which has predicted that the car could lap the Nordschleife in an unprecedented 4 minutes 59 seconds. For context, the current electric record is 6 minutes 5.336 seconds, set by the Volkswagen ID.R in 2019, while the outright record stands at 5 minutes 19.55 seconds, set by the Porsche 919 Evo.

> *"I'll come back to Le Mans with my own car one day, and I'll win this race"*

To achieve that, Perrin plans to deploy front and rear DRS, as part of an aero package developed specifically for the Nordschleife. There will also be bespoke tyres and a twin-motor four-wheel drive system based around Formula E motor technology.

In their most powerful configuration, the current Formula E motors produce 350 kW. Putting two of these together would give 700 kW (939 bhp) without any modifications. That's already close to the 750 kW (1,006 bhp) Perrin has calculated that the car would need to achieve its lap time target. Indeed he believes 800 kW (400 kW from each motor) is possible with the current technology.

His team has designed the battery in-house around a high-performance cell design sourced from an Asian manufacturer. This will provide 750 kW of traction power, optimised for a single flying lap of the Nordschleife, with a total capacity of 55 kWh. With tweaks to the cooling system and the electronics, Perrin believes the battery will be able to meet the full 800 kW potential of the motors.

"There is no existing battery that could do what we wanted, so we had to design one," he explains. "We've calculated that the net energy for a five-minute lap is 41 kWh, including regen. You need a 25 per cent energy margin on top of that, otherwise you'd get into low voltage issues with the cells."

For comparison, a Gen 3 Formula E ▶

battery offers a gross capacity of 47 kWh, with the useable capacity capped at 38.5 kWh. To take that technology and scale it up to the required capacity would add another 100 kg onto Perrin's target battery weight of 275 kg, he says. The team is carrying out all of the integration of the cells itself, including the mechanical design of the pack and the cooling system, but Perrin says they have experienced Formula E suppliers lined up for the production.

Four wheel thinking

Each axle on the 424 BEV has one motor driving through a conventional mechanical limited slip differential. There is no mechanical connection between the front and rear halves of the powertrain, giving an infinitely variable torque split, both during acceleration and regenerative braking.

"In theory, we could regen at up to 600 kW, but we don't actually need to regen from an energy standpoint. Instead, we're going to use 400 kW of regen as a vehicle dynamics tool to stabilise the car during braking," explains Perrin.

"Ideally, on any racecar you want to shift the brake balance rearwards during the course of a braking event. As you start braking in a straight line from a very high speed you mainly want to use the front axle to slow the car, but as you begin to release the brakes you want to shift that backwards to aid rotation into the corner. That's what Formula 1 and Formula E cars do with their brake by wire system."

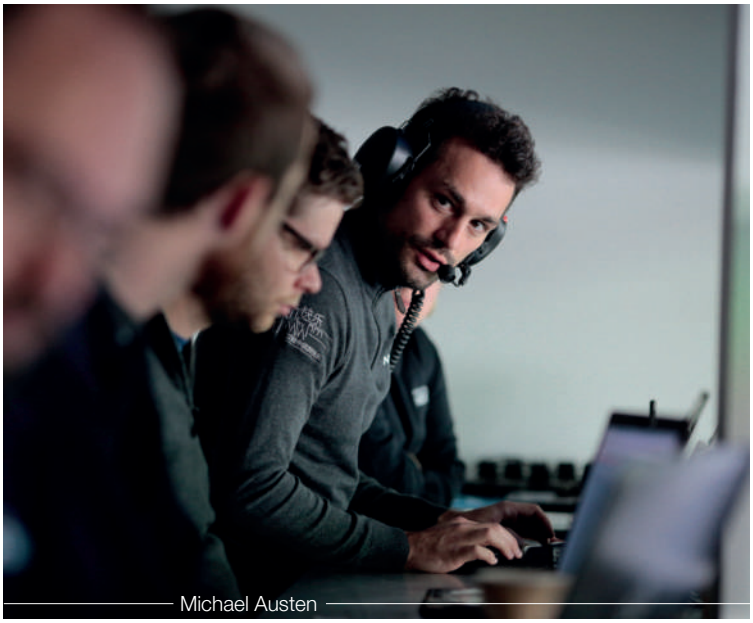
When Perrin began his career in non-hybrid LMP1, the cars were set up with a fixed bias for each session, which was typically in the region of 65 per cent towards the front. This provided the all-important stability at high speeds, but it meant engineers needed to "play tricks" as he describes it to get the car to turn in.

ABOVE At present the Perrinn 424 BEV exists only as a digital model – including the key mechanical aspects and all the aerodynamic surfaces

> *"There is no existing battery that could do what we wanted, so we had to design one"*

Perrin wants to avoid this with the 424 BEV, but he also wants to avoid using a conventional brake-by-wire system where an actuator is used to apportion brake pressure between the front and the rear. Instead, he will use LMP1 carbon-carbon brakes from Brembo, set up with a fixed bias between both ends, but only configured to provide 70 per cent of the maximum braking force; the remaining 30 per cent will come from the regenerative braking.

This approach will allow the Perrinn engineers ▶



BELOW Nico Perrin is a man on a mission, using his experience in everything from F1 to Formula E in a bid to take his own cars to glory at Le Mans

Michael Austen

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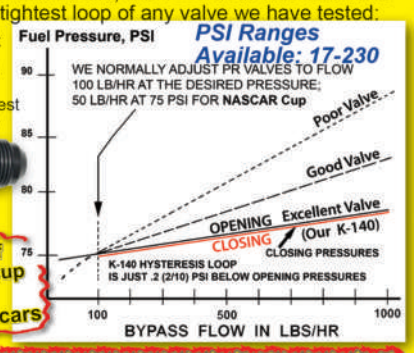

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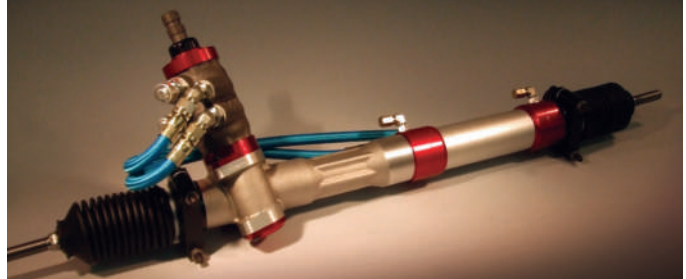

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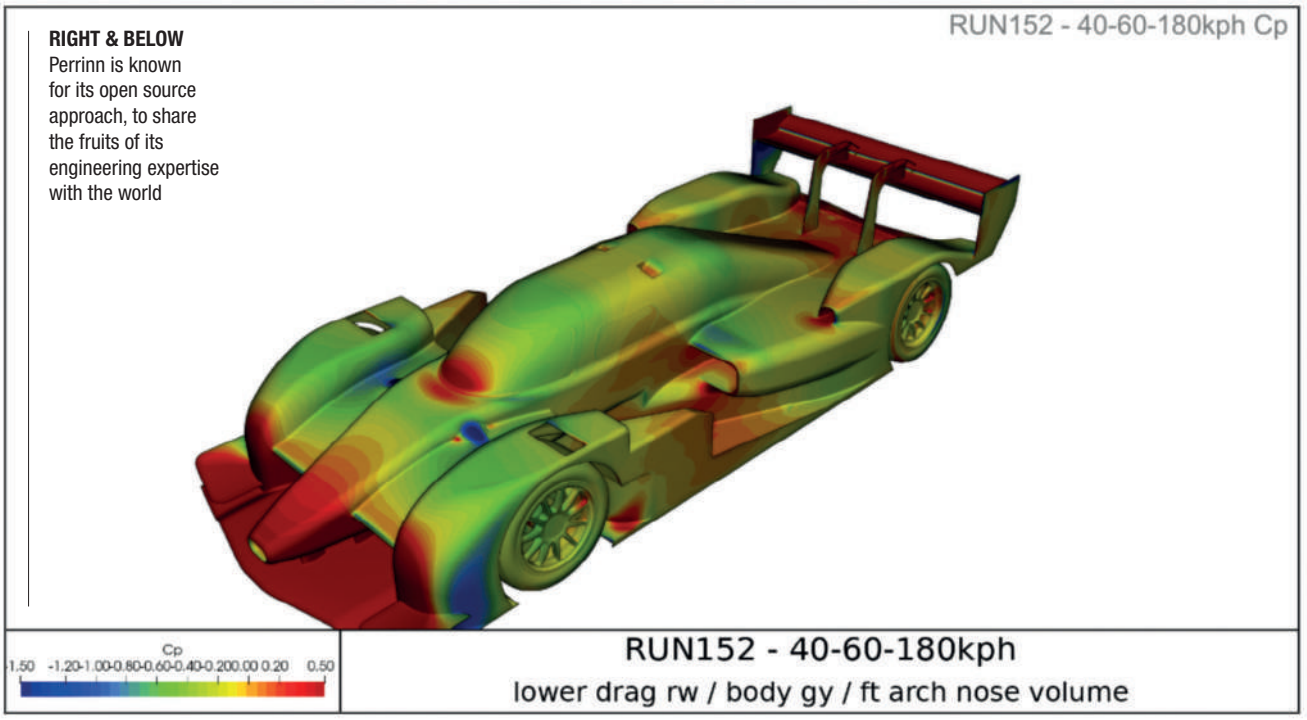


RIGHT & BELOW
Perrinn is known for its open source approach, to share the fruits of its engineering expertise with the world

to push the brake bias rearwards as the driver prepares to turn in. It also means that they can control the locking characteristics of the differential by altering how much of the braking torque goes through the calipers and how much is fed into the driveshafts, which can be used to prevent the inside wheel locking on corner entry.

Business model

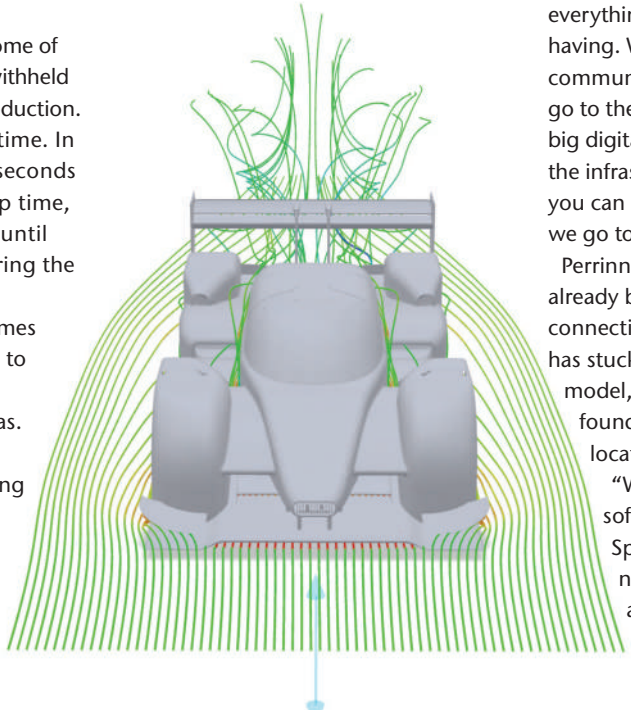
At present, the 424 BEV exists purely as a digital model. This includes the key mechanical aspects and all the aerodynamic surfaces, although some of the details are being deliberately withheld until the car is ready to go into production.

"The design is evolving all the time. In the last year we've knocked 2.5 seconds off the simulated Nordschleife lap time, so there's no point freezing that until we are ready to start manufacturing the car," Perrin explains.

When will that be? Well, it all comes down to investment. Perrin hopes to have secured enough funding to greenlight the project by Christmas. He then plans to follow a similar timeline to the NIO project, splitting the programme into three equal parts: The first six months will be devoted to finalising the design with a team of 10 engineers; the next six months on manufacturing and assembling the car; and the final six months on testing and the record attempt itself.

There's nothing particularly radical about the timescale, but Perrin plans to apply his own progressive approach to every stage of that process.

"We want to build a race team of a different nature, one that's not just for the age of electric power, but also the age of the internet, the age of AI and all the other changes we are going through," he comments.



"I want to build a team that can take on Porsche and Ferrari, but I want to do it around a new business model. We've learned so much from social media about the power of allowing people to come in and build communities around projects. The team is very accessible and open. We publish a lot on LinkedIn at the moment, but the day we launch our 18-month campaign to break the record at the Nürburgring, we're going to start a live documentary.

"So, we are going to show absolutely everything we're doing, the issues we're having. We're really going to build a big community around this. Then when we go to the Nürburgring it's going to be a big digital event. We're already building the infrastructure to support that. And you can imagine what it'll be like when we go to Le Mans in that format."

Perrinn's core team of 10 engineers has already been assembled – mostly through connections forged online. The team has stuck with its decentralised business model, and Perrin says they haven't found any drawbacks so far to being located in different parts of the world.

"We use our own simulation software for 424, which was built in Spain by one person with a small network of passionate people around him," he says. "That would never have happened if I'd

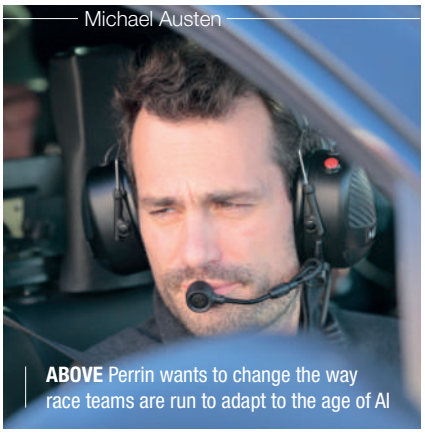
tried to keep everything in the UK, given the resources we had available."

Another example is the team's approach to simulation: "We've solved a notoriously hard problem in motorsport by building an AI driver that can actually drive the car as fast as a human being," he adds. "The reason we've been able to do that is that the open source concept caught the attention of some AI experts in America who were passionate about getting involved in the project, but who would not have been able to relocate to the UK for a conventional team.

"Similarly, we made connections in Hong Kong who allowed us to find access to the battery technology we needed. This approach enables us to do things better but also to reduce costs at the same time, which is important. And I believe when we apply this at scale it will help us to win too."

Perrin estimates that the full Nürburgring record programme will require £7.5 million of investment. So far, £2.5 million has been raised and Perrin is looking to match that with a new round of investment before the project commences. We're told the final £2.5 million has already been pledged in sponsorship on condition of the £5 million target being reached.

The key appeal for the investors, Perrin says, is to secure equity in the team now before it begins to scale up for the Le Mans campaign. He likens it to buying shares in a team like Red Bull 20 years ago. Additionally, while the majority of the technology will remain open source, the team aims to withhold the IP on certain key aspects to open up another revenue stream.

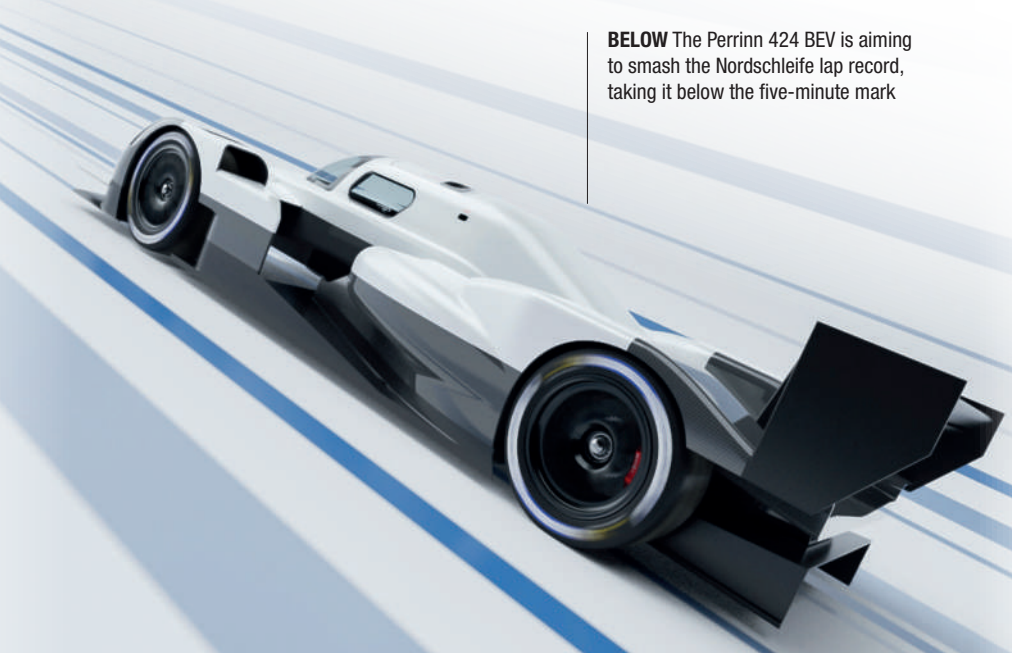

Michael Austen

ABOVE Perrin wants to change the way race teams are run to adapt to the age of AI

> *"We want to build a race team for the age of the internet and the age of AI"*

Ultimately, Perrin also wants to add a crowdfunding aspect, but he's taken the decision to delay that until the company has raised its profile with the Nürburgring attempt.

"I think it's a little early for a crowdfunding campaign to be successful, so that's why we're staying with traditional equity for now. But once it comes to Le Mans, people will have an opportunity to literally own a part of the team."



BELOW The Perrinn 424 BEV is aiming to smash the Nordschleife lap record, taking it below the five-minute mark

The final part of the puzzle, he says, will be to get an automotive OEM onboard for the push to Le Mans: "We have an incredible business model that's very innovative. We want to use that as a platform to host some major brands and take them to Le Mans with a fuel cell car. We hope to become a fully-fledged race team with backing from a major manufacturer – and specifically at a time when we believe the electric car market will really start to flourish."

Clean sheet

The 424 BEV design has developed over time from the original Perrinn LMP1 concept, but after seven years of evolution it no longer shares any components. If the hydrogen-fuelled 424 FCEV gets the go ahead, it will be a completely clean sheet design, although the 424 branding and parts of the design philosophy will be carried over.

"We already know the FCEV will have to be a bit longer. The battery will reduce in size, but we'll need to accommodate the fuel cell," he notes. "The monocoque would need to be changed, but the basic concept with the twin motors and the four-wheel drive system are part of the foundation of what we're doing."

Perrin already has a potential supplier in mind for the fuel cell, but he acknowledges that the technology still needs time to mature.

"Fuel cells are good for heavy industry. They're not light enough for motorsport yet, but that will come. If we started development today, I think it would take about two years to reach that stage," he predicts. "There are also the challenges that fuel cell cars share with hydrogen combustion, such as hydrogen storage on the car and infrastructure at the circuit. We're ready to work with suppliers on those points in the coming years, but the battery electric technology for the Nürburgring record is already here and fully understood."

That's the crux of this project. There's a lot of work still to be done, but there's real substance here too. Perrin's last project was working on a championship-winning Formula E car; the one before that a longstanding EV record holder at the Nürburgring. He may be a dreamer, but he's better placed than most to make that dream a reality.

GOLDEN AGE FOR MATERIAL BENEFITS

Bcomp's Johann Wacht tells **Chris Pickering** about the Swiss company's sustainability journey with its products such as AmpliTex

ONE of the awkward truths about sustainability is that it's not the existence of green technology that benefits the planet, but the extent of its adoption. Showcasing a prototype technology will only get you so far; to make a real impact it needs to become a commercially viable proposition.

"You can call it the Valley of Death," comments Johann Wacht, manager for business development and strategic customer relationships at Bcomp. "You have the early adopters who are willing to take risks and maybe compromise in some areas to embrace a new technology. And then you have mass market adoption, where no one is making any allowances. A lot of technologies and companies fail to make that jump. With the BMW M announcement [that it will incorporate natural fibre composites in some future production models] we have now proven that we have passed through this valley, a huge success for us as a company and for high-performance natural fibres as a technology."

Bcomp, however, is confident that its sustainable composites have successfully made that transition. And it's marked by a shift in customer expectations, Wacht explains.

"The golden brown colour of our original AmpliTex material came from its flax base material, and it stood out because it was a composite part, but it was very obviously not carbon," he says. "Once the early applications proved that these materials do work well on a racecar, we started getting other people saying, 'okay, it's performing, but we don't like the brown colour, can we have something that is easier to incorporate with other colours and materials while still remaining unique?'"

Bcomp's answer was to develop a range of coloured AmpliTex materials, including the signature Bcomp Grey, which looks much like traditional carbon fibre.

The Swiss firm already has a history of working with major manufacturers on low volume projects. This includes a longstanding collaboration with Porsche on its GT4 customer cars and Skoda on the Fabia Rally2. Another key customer was BMW – initially starting with Formula E in 2019 and then as an official partner to the M4 GT4 from 2022. Recently, it was announced that BMW will soon be adopting the new coloured AmpliTex on a number of series production models. Having progressed from one-offs to customer racecars, this is the material's first use on a production road car. It marks Bcomp's first truly mainstream application.

With that progression comes new challenges. Composite materials can visibly age over time; not generally an issue for the motorsport market but a key factor in series production, where a car may be parked on the street for a decade subject to UV and moisture. So Bcomp has had to carry out ageing testing to determine the long-term behaviour of the material.

Photos: Bcomp

ABOVE At the 2025 Nürburgring 24 Hours the Four Motors Porsche GT3 Cup car used exterior body components produced with Bcomp's grey AmpliTex

LEFT Bcomp uses flax base material for its composites, offering a green alternative to carbon fibre for its products

Puzzle pieces

The process of refining AmpliTex from the original material into something that can be used on the interior of a road car has taken around four years. It required the team to re-evaluate everything from the sourcing of automotive-grade flax yarn and the colouring of the material through to the environmental protection measures that are applied to maintain its appearance.

"It's comparable to the colourisation process for premium clothing," says Wacht. "Dying linen is one of the most ancient technologies – we've been doing it for tens of thousands of years. But obviously you can dye material in very different ways, and they have all their pros and cons to develop. Finding a colouring process that was able to withstand the processing and ageing requirements was a big challenge."

As with textiles, there are different approaches. Bcomp tailors its process – including the point where the dye is applied – based on a number of factors, including the customer's desired design finish, the chosen manufacturing process and where the parts will be used on the car. In some cases, the natural fibres are combined with thermoplastics, so Bcomp worked with its partners on thermoplastic development. In other cases, a thermoset process is used, which led to the development of new resin systems.

> *"The golden brown colour stood out because it was very obviously not carbon"*

"Exterior thermoset parts are definitely the hardest challenge," adds Wacht. "If ▶

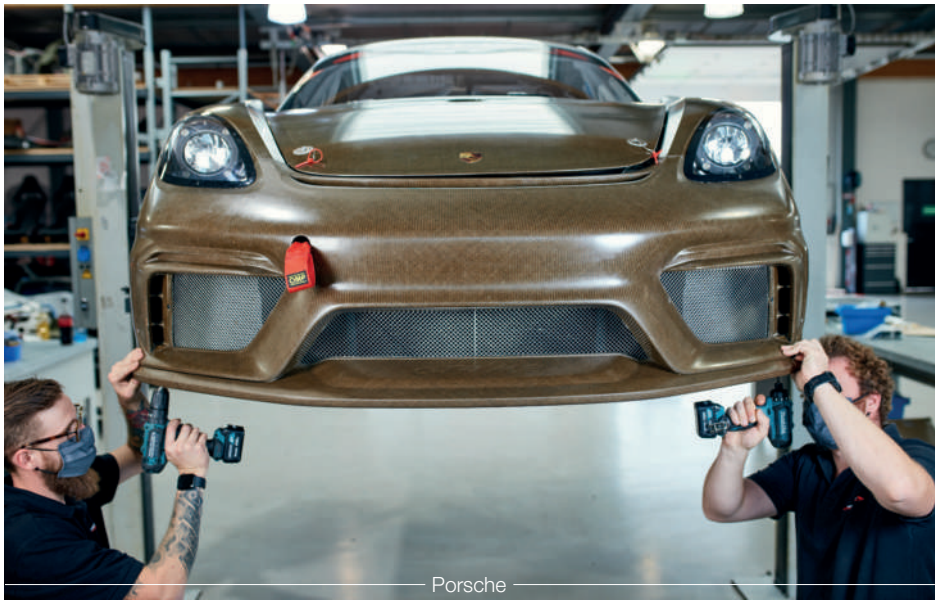
you just take the old material and use the new resin system, it doesn't work. Likewise, if you combine the new material with the old resin. There are a lot of different pieces of the puzzle that need to fit together. In the end, it's a lot about the processing and the finishing."

Ageing tests

One of the trickiest applications came from Bcomp's work with BMW, where the material has been used for composite roofs, as Wacht explains: "The composite roof is an iconic feature that has a lot of heritage with BMW, so we're extremely proud that we could meet all the requirements for that application with a natural fibre composite. It's under structural loads; it has to undergo crash testing; and it's a very visible part."

The mechanical properties of the new Bcomp Grey are said to have improved slightly over the original AmpliTex material, but Wacht says it's the ageing performance which really sets the new material apart.

"When you look at some of our older parts from 2019 or 2020, they are a bit lighter in colour now than they were originally. That's not the case in all situations – there are ways to manage that, and if you look at the Porsche rear wings from 2019 they look just as good today, but that's with cars that are kept in a motorsport environment. A production


Porsche

Bcomp

BELOW RIGHT This seat made for Lando Norris at McLaren was the very first F1 car part to be made of renewable textile fibre

BELOW Manthey Racing's prototype Cayman 718 GT4 Clubsport (above) used the original golden brown AmpliTex (below) for its entire front end

McLaren Racing

> *"The technical challenges we face in series production are quite different to motorsport"*

part faces very different requirements."

The development work relied heavily on accelerated ageing tests, where 20 years of ageing can be simulated in two weeks. However, these tests were developed for traditional materials like plastics and cotton, so one of the first tasks that Bcomp undertook with BMW was to investigate the various test protocols. In the end it was concluded that the best policy was to stick with the recognised industry-standard tests.

"A lot of the technical challenges we face in series production are quite different to motorsport," he adds. "There's not a lot of technical crossover into things like ageing tests. On the other hand, it's a proof of performance, if a material can survive four years of racing in the Nürburgring, from 40 degrees in the sunshine to events in the snow. Working with the OEM motorsport departments really helps there.

"The other thing that's very important is that it introduces the technology into the OEM supply chain. It's simple things like already being registered with the OEM's purchasing department, so you already have a supplier number, and establishing relationships with people ▶

in the motorsport department who can pass their experience of the material onto their colleagues on the production side."

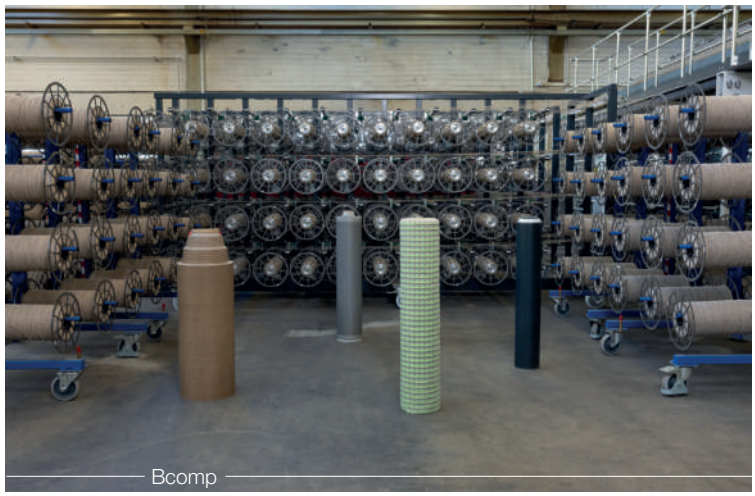
CO2 savings

While the ability to compete on equal terms with conventional materials may be a key indicator of commercial readiness, one of the core benefits of AmpliTex remains its environmental performance. The results vary. In some cases, Bcomp says its materials can deliver CO2 savings of up to 85 per cent. Elsewhere, the gains can be more modest but still significant; BMW claims a 40 per cent reduction in CO2 equivalent emissions over the complete lifecycle of the part. This includes the base materials, processing and end of life considerations.

In motorsport applications, Bcomp makes extensive use of its powerRibs technology. This is a three-dimensional support structure that can be placed on the underside of the part, bringing its overall performance up to a comparable level with a traditional carbon fibre part.

> *"Bcomp says its materials can sometimes deliver CO2 savings of up to 85 per cent"*

For production parts it's more complex, as it's very difficult to achieve an A-class surface on a thermoset part with powerRibs. In some cases, it's possible to address these challenges by carefully tailoring the properties of the base fibre, but Bcomp is still working on others. Typically, Wacht claims, it's possible to produce a part that is roughly equivalent to carbon fibre in terms of strength and ▶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ABOVE Bcomp's technology has become more mainstream as its sustainability journey has progressed

BELOW & INSET BMW Andretti's Formula E team was another beneficiary of Bcomp's composite materials – as seen in its cooling shaft (inset)

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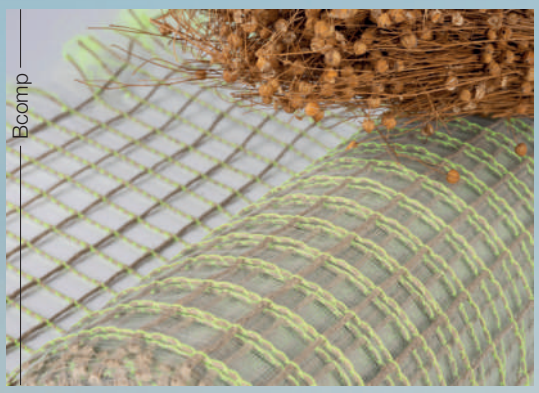
weight, though he believes the importance of this is sometimes overestimated. [Crucially, the cost is also said to be comparable.]

"If you look at, say, a Formula 1 bodywork component, the performance requirements are very different to a GT3 car. Building a part to F1 spec would be complete overkill for a GT car, but that's what we quite often see happening at the moment. The important thing isn't whether a new material can match the exact same strength and stiffness, but whether it's capable of fulfilling the same role," he notes.

Wacht originally came into contact with this technology when he was leading a project to build the world's first natural fibre monocoque. The team succeeded, but that doesn't mean it's a logical use of the material, he points out: "You can do it but the question is: does it make sense? When it comes to monocoques, traditional carbon fibre is definitely the lighter option. I firmly believe that you should use materials where they are most suitable. Carbon fibre has its strengths and its weaknesses – it performs very well in structural parts. But as soon as you go to larger volumes in the bodywork and the interior, natural fibre materials come into their sweet spot."

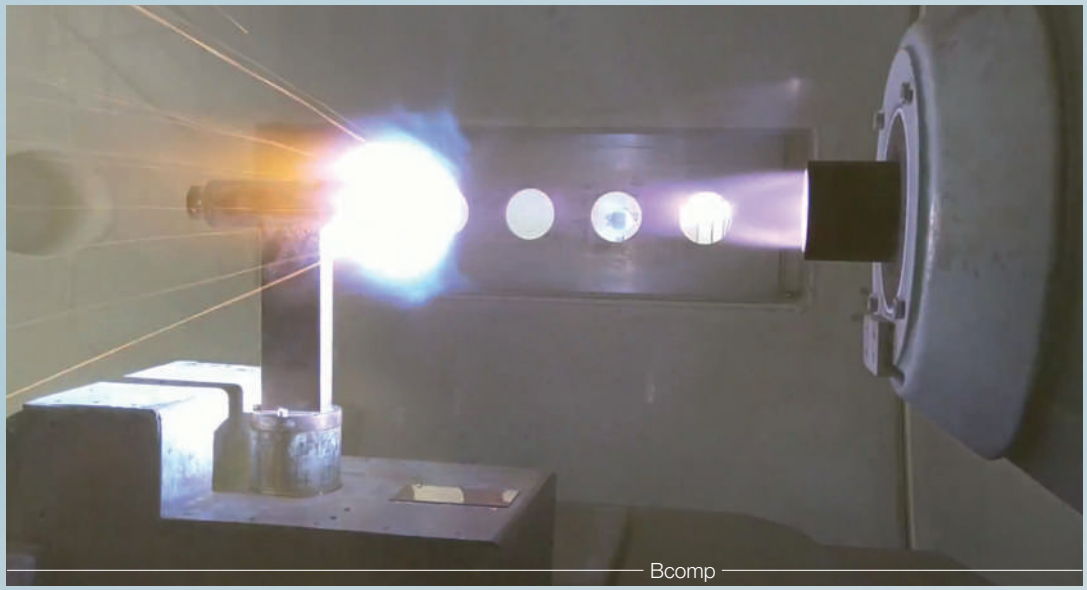
> *"We imagine a future where people would instantly recognise a Porsche wing or a BMW wing"*

There are plans afoot to develop hybrid materials with carbon fibre spines paired with large areas of natural fibre. This, Wacht says, could lead to the



LEFT Bcomp makes extensive use of its powerRibs technology, a three-dimensional support structure that results in similar performance to traditional carbon fibre parts

BELOW Series that have made use of Bcomp technology also include NASCAR with its EV prototype


Bcomp

LEFT Bcomp's flax-based biocomposite structural panels are finding applications in space missions. Here they are tested for demisability in simulated re-entry conditions using a plasma wind tunnel

best of both worlds.

Another thing to bear in mind, he says, is that traditional carbon composites are typically very uniform in appearance: "When it comes to natural fibres, we are creating new identities. An OEM can have a specific yarn, colour or weave pattern, so that when fans look at it they can recognise it as a signature of that brand. If you go through the GT paddock, the rear wings all look pretty much the same... but we imagine a future where each OEM has its own design, so people would instantly recognise it as a Porsche wing or a BMW wing. It's creating an added value that's not present with carbon."

Having tested the material with a range of GT4 manufacturers, not to mention higher performance applications like Super Formula and Formula 1, Wacht sees GT3 as the next step in motorsport. On the road car side, meanwhile, the push is towards greater mass adoption. After all, that's where the real impact can be made. RT

Getty Images/NASCAR

ALL OR NOTHING

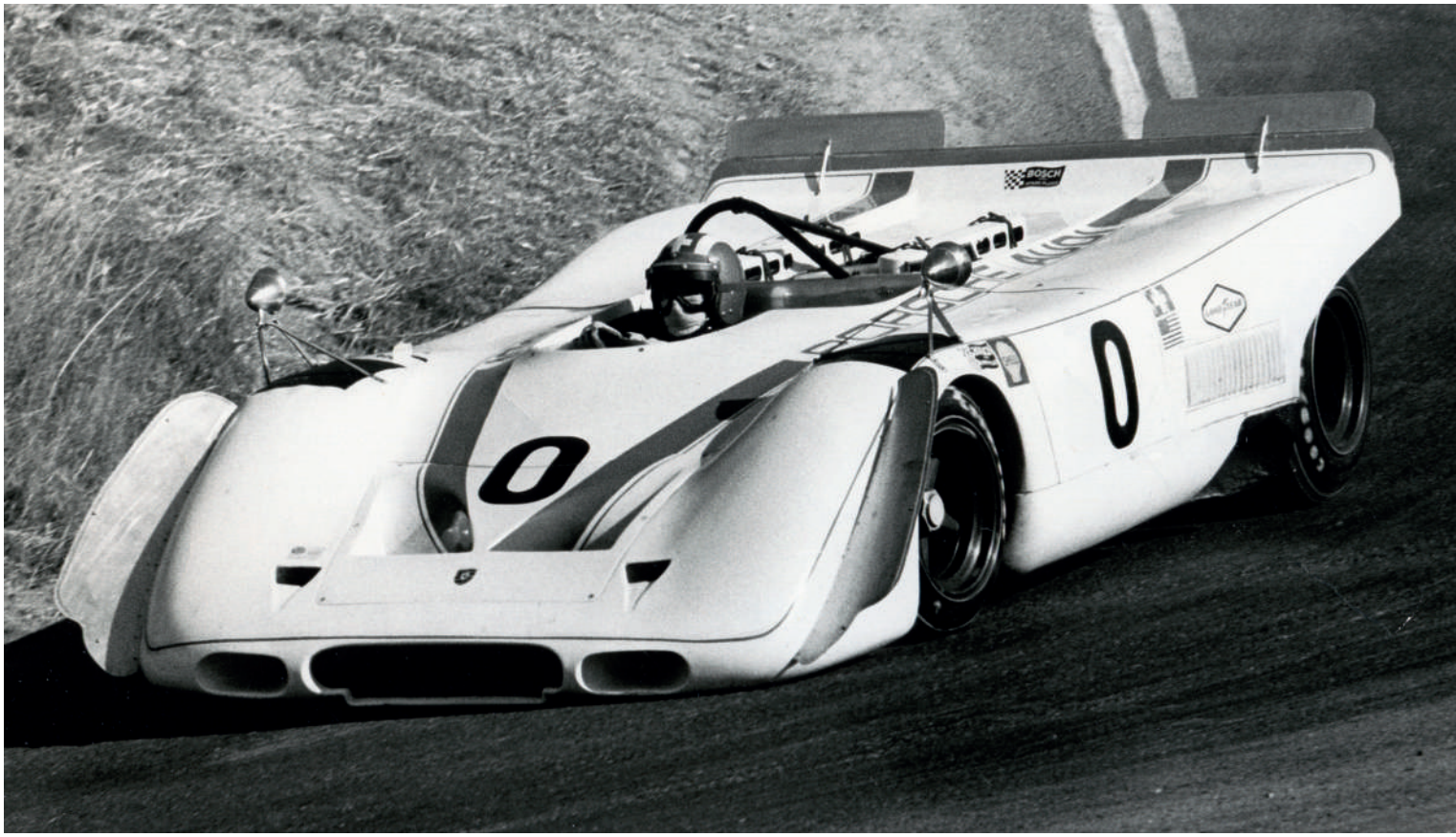
In our third extract from 'Power Unleashed: Trailblazers Who Energised Engines…', **Karl Ludvigsen** takes us inside Porsche's high-stakes bid to tame turbocharging and unleash the full potential of its fearsome Can-Am 917s

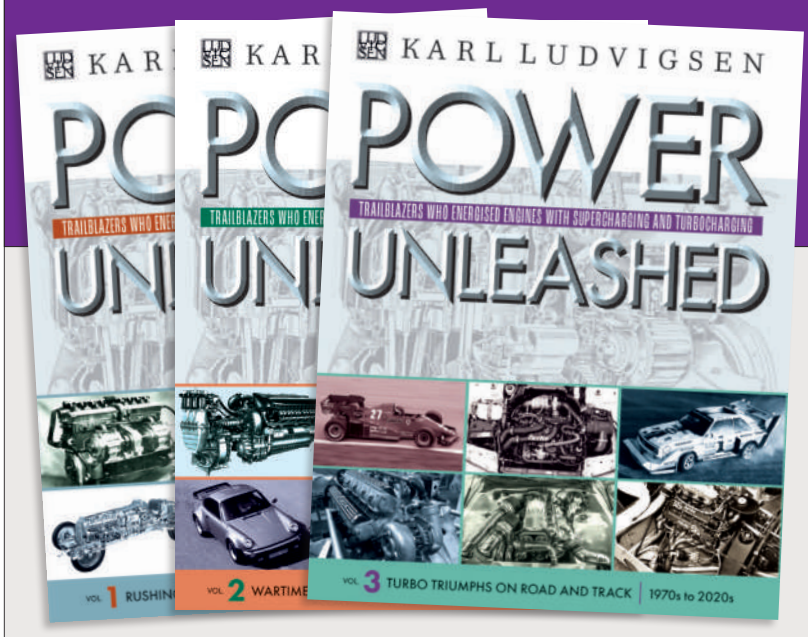
BOTH inspiration and trepidation of turbocharging for Can-Am cars were traceable to the efforts made by Porsche to exploit its grasp of the technology. Turbos were no strangers to Porsche's headquarters in the Stuttgart suburb of Zuffenhausen. As we read earlier, it had even built turbocharged Beetles during the war. But Porsche's first foray into the Canadian-American series in 1969 was by a roadster or 'spyder' version of its Type 917 endurance-racing car, built specifically to be raced by factory favourite Jo Siffert. Though a late entry, Siffert and the 917PA (for the American entrant, importer Porsche+Audi) placed fourth in the championship.

Milt Minter was sixth in the 1971 standings with the same car and Siffert fourth again with an improved spyder, the 917/10. The latter showed that Porsche was getting serious about an entry in the popular Can-Am series. But competition in the series had turbocharged the efforts of the teams to have more horsepower in better cars. Winning was a moving target. With their modified Chevrolet V-8 engines as big as 8.2 litres the dominant McLaren team had access to 730 horsepower and 600 lb-ft of torque. What was the solution?

The Porsche 917's air-cooled flat-12 engine was no slouch in power production. Enlarged to 5.4 litres it generated 660 bhp at 8,300 rpm and 470 lb-ft of torque at 6,400 rpm. Good, but only for also-rans. For development chief Ferdinand Piëch, racing designer Hans Mezger built a flat-16-cylinder version of the 917's engine that produced 755 bhp and 542 lb-ft of torque. In the car, however, it was a disaster. Engineering director Helmuth Bott decided: Porsche would build a turbo-supercharged engine for the Can-Am series.

By 1970 experimentation with turbocharged engines was under way at




KARL LUDVIGSEN
POWER
UNLEASHED
TRAILBLAZERS WHO ENERGISED ENGINES WITH SUPERCHARGING AND TURBOCHARGING
VOL 3 TURBO TRIUMPHS ON ROAD AND TRACK | 1970s to 2020s

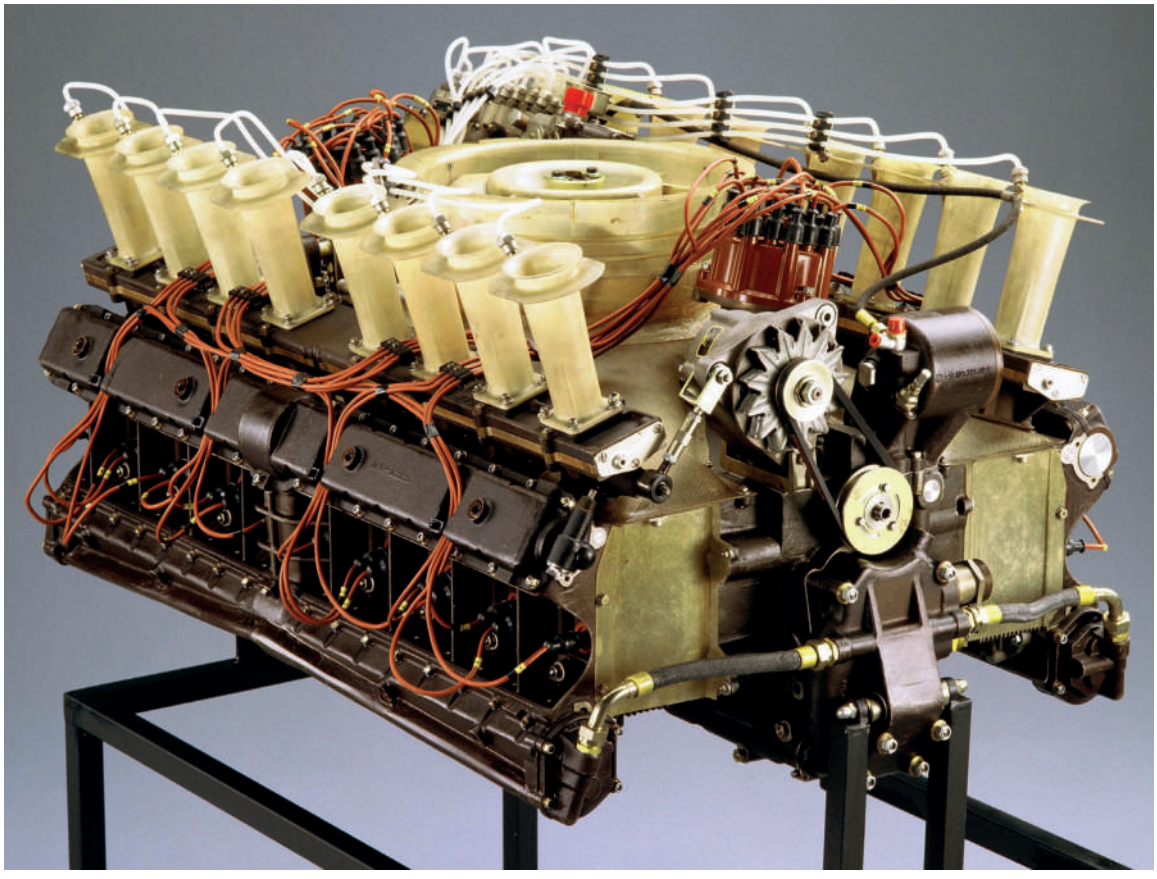
POWER UNLEASHED: Trailblazers who energised engines with supercharging and turbocharging

Written by **Karl Ludvigsen**.
Published by Evro Publishing.
Price: £395. ISBN: 9781910505373

In a three-volume work of astonishing depth and detail, complete with reader-friendly technical descriptions and magnificent illustrations, Karl Ludvigsen introduces the fascinating individuals who bet their businesses on boosting

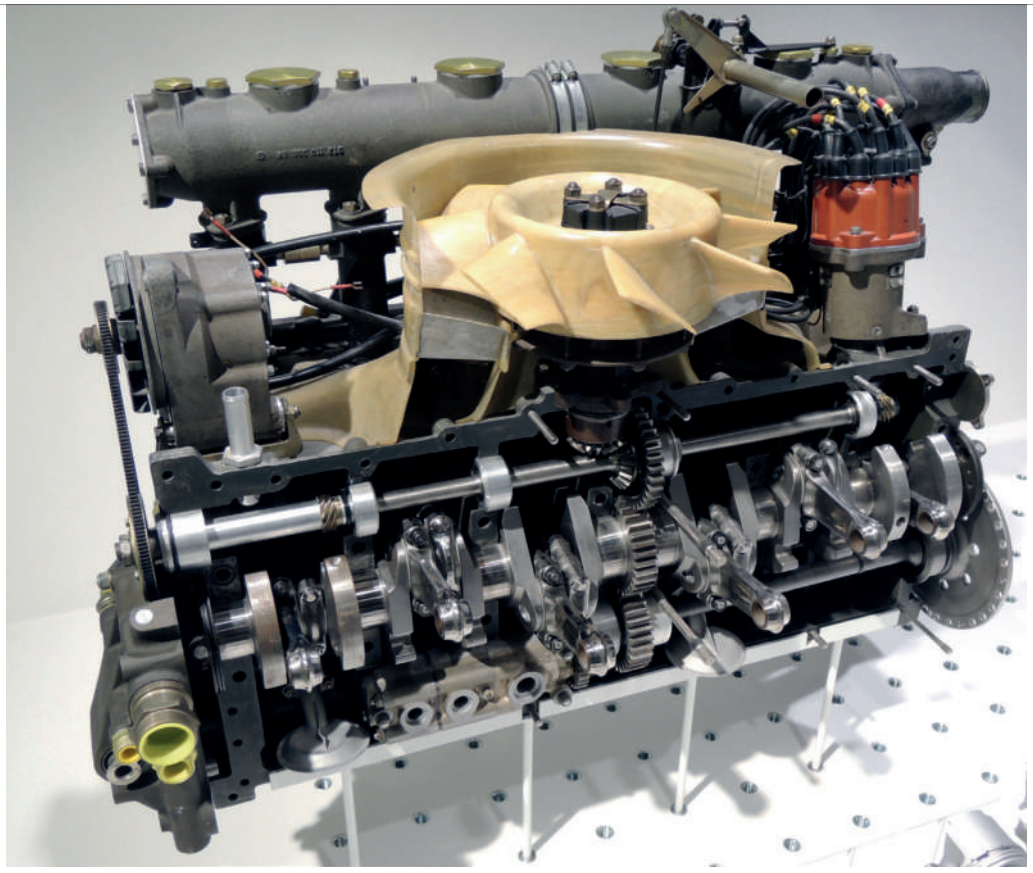
Zuffenhausen. The first tests were carried out on a 2.0-litre Type 901 engine with a Bosch fuel-injection system. In 1971, when Porsche confirmed internally its plans to go Can-Am racing, the development of a turbocharged engine shifted into high gear in parallel with the work being done on the new Type 917/10 chassis and body.

Each of the cylinder rows of the Porsche flat-12 was given its own turbocharging system. This duplication was implemented because the rotating inertia of each of the two small blowers was much less than that of a single large one. Eberspächer supplied the turbos. Based in Esslingen, it had design links with Garrett AiResearch. Under Hans Mezger's supervision their ▶



LEFT Attracted by the prize money in the Can-Am series, Jo Siffert persuaded Porsche to make a roadster version of its 917. In the 917PA he was fourth in the 1969 standings

RIGHT In its no-holds-barred era under Ferdinand Piëch, Porsche built this flat-16 as a possible Can-Am engine. Its 755 bhp were great on the dyno but not in the overly long racing car



RIGHT For the Can-Am, Porsche turned its attention to the proven flat-12 engine. This cutaway reveals its central gearing and, at top, the manifolding of the turbocharged version

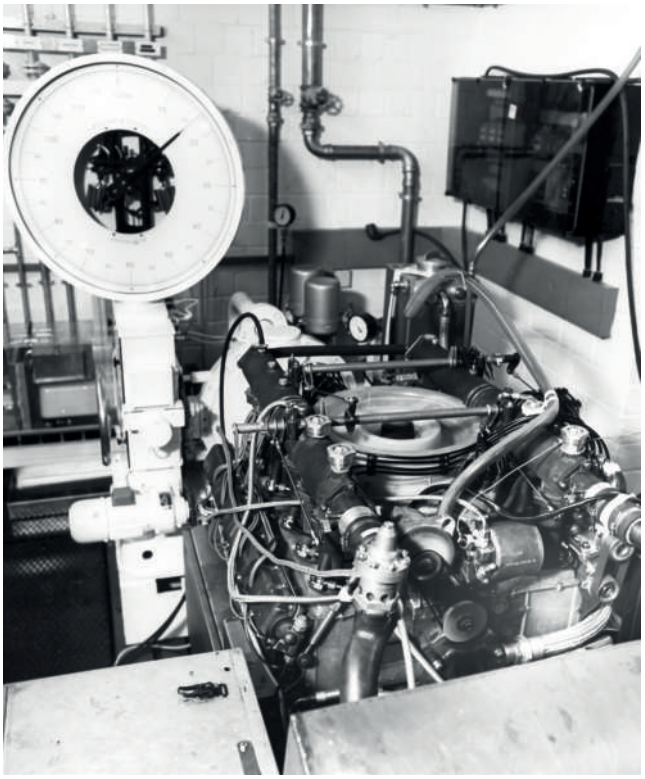
BELOW Pictured in operation, this high-capacity dynamometer served for the development of the turbocharged flat-12. A single wastegate drained the surplus energy of two turbos

BELOW RIGHT A veteran of Porsche's first modern turbocharging efforts, Valentin Schäffer worked both in the laboratory and in the field to perfect the initially balky Can-Am turbos

units were applied to the flat-12 by Valentin Schäffer, a stocky, broad-nosed fireplug of a race mechanic who, said Mezger, wanted 'to work more like an engineer. He became involved in all the experimenting that we did on the turbo.'

Schäffer's first system was as simple as he could make it. Two turbos pumped air into log manifolds feeding the inlet ports of a fuel-injected 4.5-litre twelve. Maximum boost pressure was limited the same way it was in Indy cars—by a single AiResearch wastegate, in this case attached to the exhaust pipes of both banks at points upstream from the supercharger turbines.

Even with boost control, durability of the first blown engines was not the best. By early summer of 1971 the first such engine was installed in one of the latest chassis and taken to Weissach to see how it behaved. Tester and racer Willi Kauhsen recalled what happened: 'When I settled into the car and started to warm up the engine, the windows shot up in the nearby buildings and the



Porsche people waited eagerly for the "turbo" to appear. But the first times out I rarely covered more than 500 meters!'

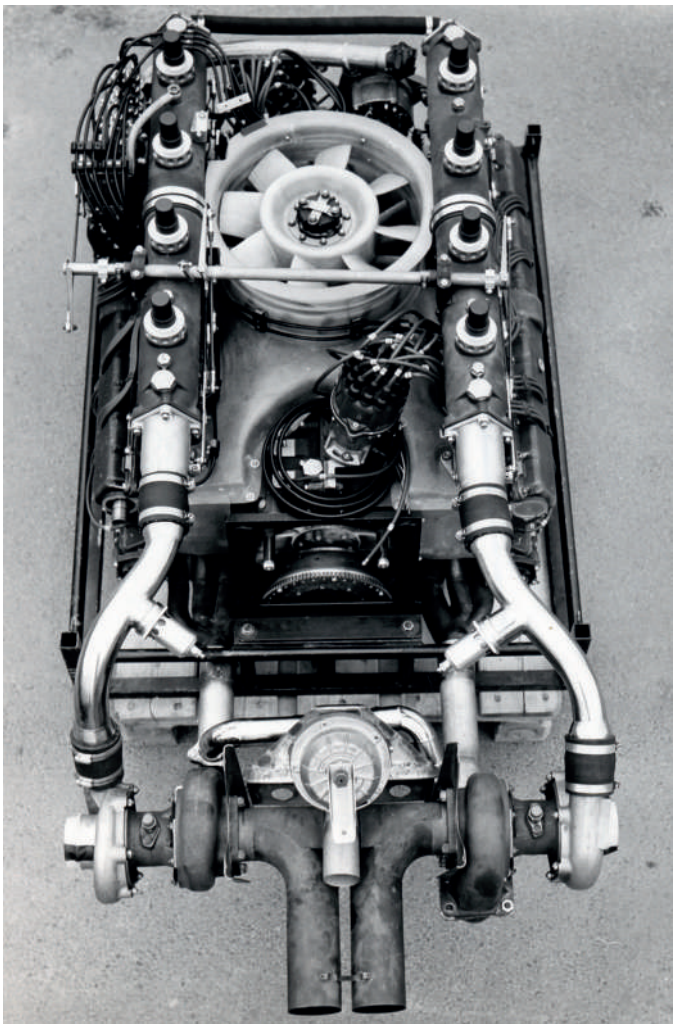
Valentin Schäffer's battle to build reliability into the blown engine was not made easier by a fire in the test cells that caused serious damage to the area where he was working. This put a three-month kink in the progress chart of the turbocharged twelve. Nevertheless, that summer of 1971 the engine was running reliably enough for Jo Siffert to try it in the first turbo 917/10 both at Porsche's Weissach proving ground and at the Hockenheim circuit.

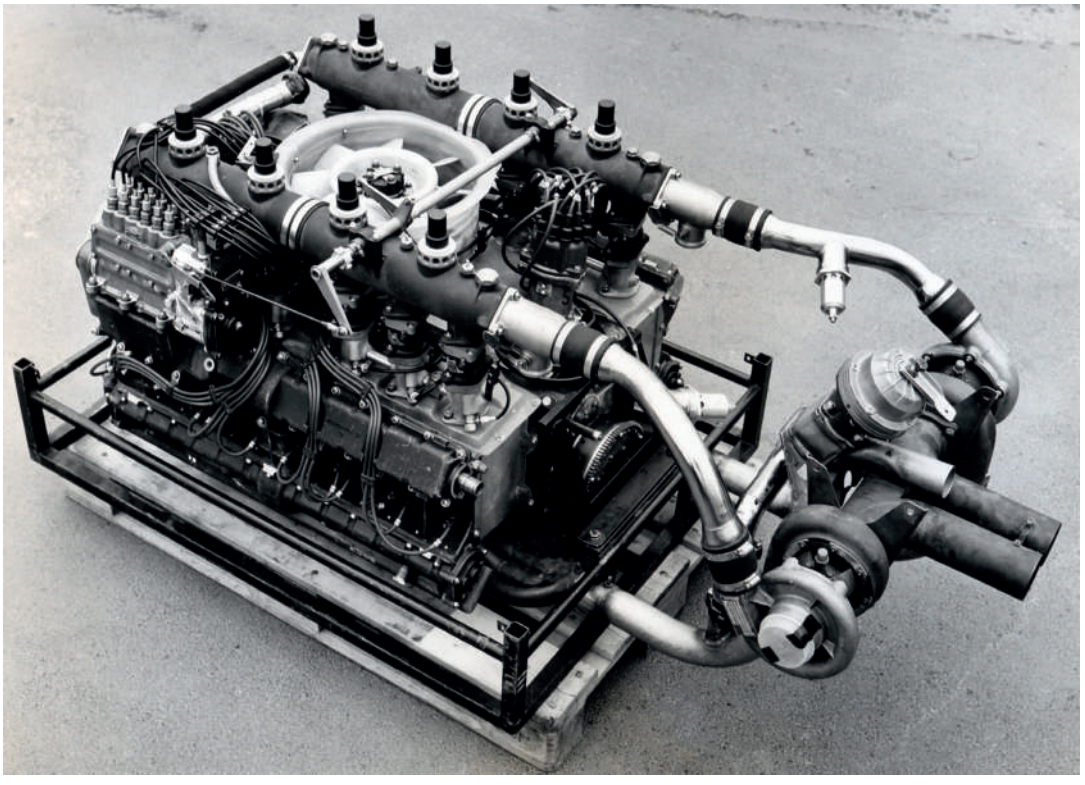
These tests were traumatic. Response to the throttle was far too slow. When the throttle was pressed coming out of a turn, long seconds elapsed before a swelling sense of propulsion against Siffert's back told him they were revving up. When he backed off for a turn those seconds seemed even longer, the engine roaring away at high boost even although he'd long passed his last braking point. More than once the white Porsche test mule bounced off the track into the boondocks with an all-but-helpless Siffert behind the wheel. Power was impressive but controllability was not.

On 2 August 1971 Porsche broke the news that it would bow out of Manufacturers' Championship racing in 1972 and race instead in the Can-Am and Interserie with cars based on the 917. On 16 November Porsche and importer Porsche+Audi announced jointly that Roger Penske's team was their chosen ally in the Can-Am under an agreement covering the 1972 and 1973 seasons.

While the negotiators dotted Is and crossed Ts and Jo Siffert campaigned the unblown 917/10 in North America, the technicians were hard at work developing the car that had to deliver for Porsche. After the first alarming track tests, turbocharged-engine development went back to the design office and the dynamometer.

Porsche's unblown test 917/10 was wearing higher-downforce ▶





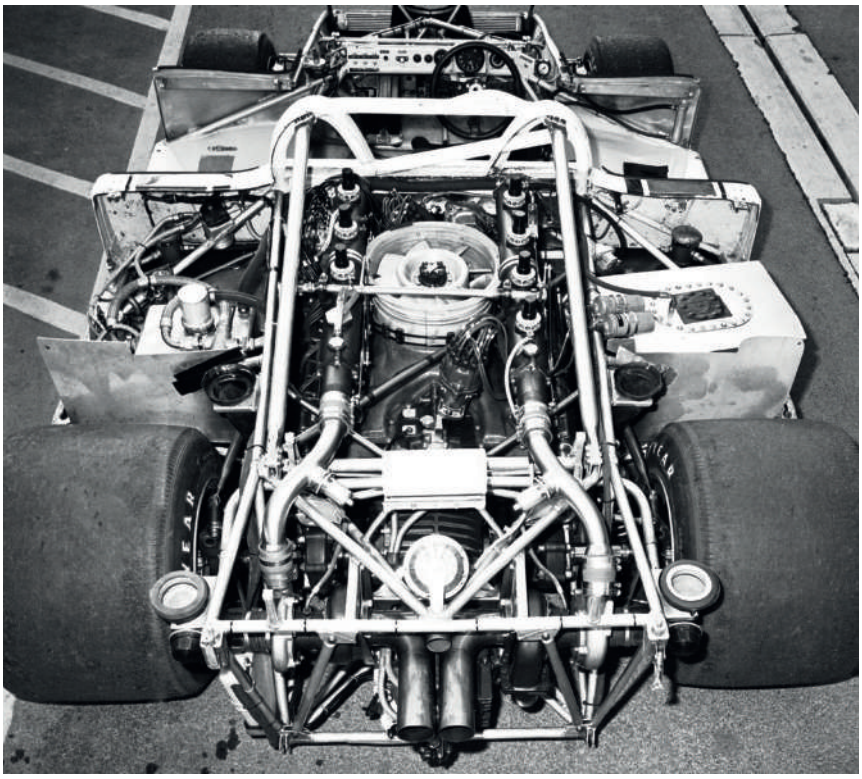
ABOVE With its twin AiResearch turbochargers the first 4.5-litre engine of 1971 produced more than 800 bhp but was unruly in the extreme as tester Willi Kauhsen discovered

LEFT The Bosch fuel injector is visible on the left. Hats on top of the manifolds were Mark Donohue's suggestion to give adequate induction air when boost pressure was low

bodywork in late October 1971 when Penske's driver Mark Donohue and racing engineer Don Cox visited Weissach for the first time. For Donohue a first encounter with that car for picture-taking and ceremonials on 26 October turned into a do-or-die challenge to improve on the 50.5-second lap record for Weissach's Can-Am track set by Willi Kauhsen after exhaustive testing.

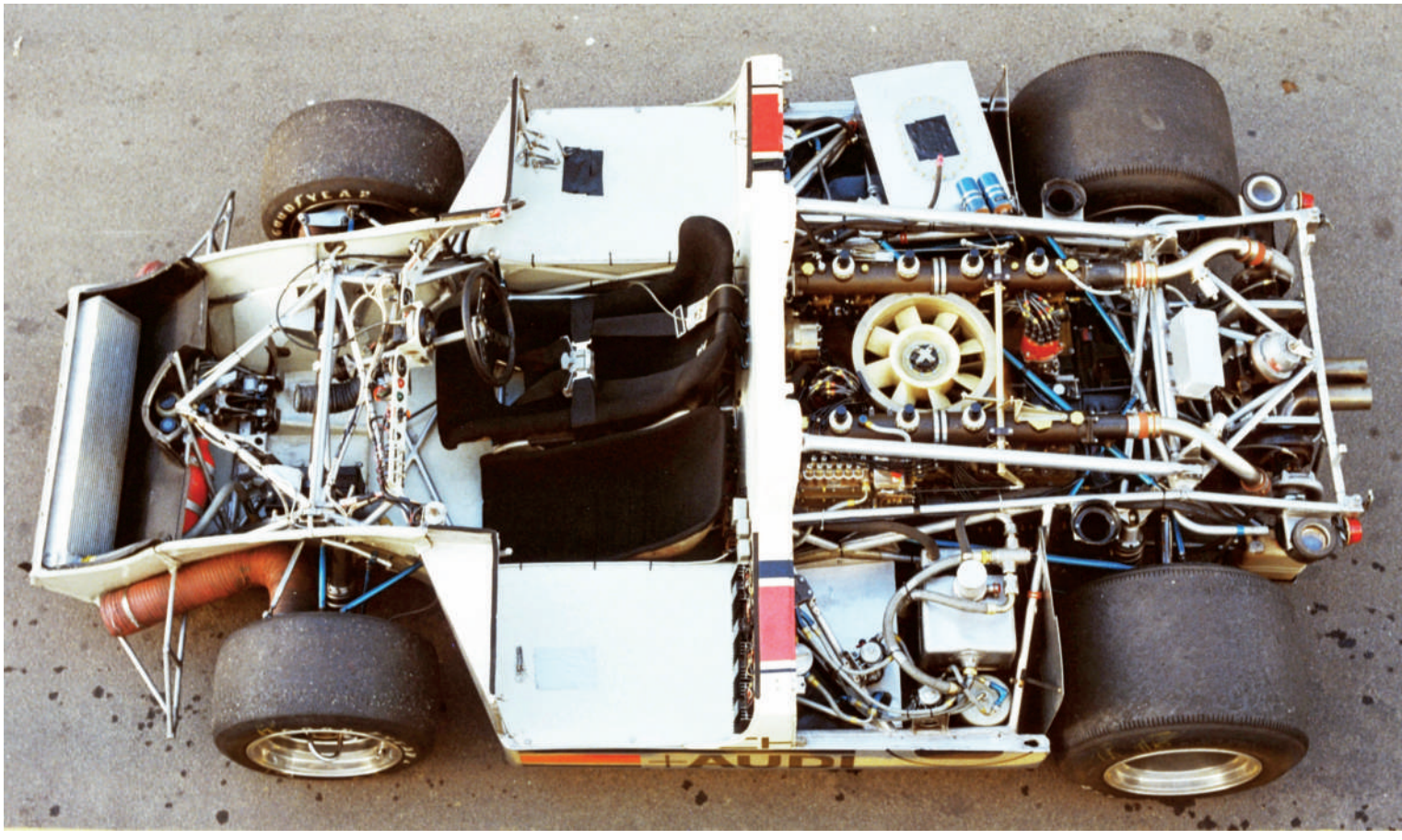
'Germans are very tough people,' Mark learned that day. 'They expect the maximum from everybody at all times.' In spite of a nagging hangover he more than met their expectations. After extensive changes were made in the chassis setup at his specific request, to moderate a high-speed oversteer, Donohue sliced the record to 49.7 seconds.

Though suffering frustrating failures during the summer of 1971, Mezger and Schäffer succeeded in making the 'turbomotor' more reliable. One area that had not given trouble was the bottom end. This was as Mezger's group had calculated it should be. 'In the case of the 5.0-litre engine,' Mezger reported, 'the maximum connecting-rod bearing load of the naturally aspirated version at its power



ABOVE Deriving its basic structure from the long-distance 917, the Group 7 Type 917/10 added all its turbo equipment at the rear. Engine-oil reservoir was at the left rear

BELOW The 917/10 shared the latest Goodyear wide tyres with other Can-Am machinery. An oil cooler was at the front and petrol at both sides of the driver and at the right rear



LEFT Lowness of the flat-12's clutch showed that the engine's central gearing drove it. In its final iteration for 1973 it was enlarged to 5.4 litres to produce 1,100 bhp on the track

peak of 8,300 rpm is at about the same level as that of the supercharged engine at its 8,000-rpm peak power speed.'

No changes had to be made to crankshaft, bearings or connecting rods. The steel shaft that took the power from the central drive gears to the clutch had to be enlarged from 22 to 24 mm. Even so, it twisted 20 degrees under the impact of the peak torque of the turbocharged engine. New pistons with almost flat crowns reduced the compression ratio to 6.5:1 to avoid detonation at the high combustion pressures reached at full boost.

For the first time in the history of the flat-12 engine, its cooling had to be increased. They exchanged the two bevel gears in the blower drive so the fan turned at 1.12 times engine speed instead of the previous 0.9. This elevated air-pumping capacity by 30 per cent to 6,600 cubic feet per minute at the cost of an 80-per cent rise in the amount of power required to drive the fan.

To improve the engine's mid-range running when the turbocharger was off boost, its inlet timing was made milder by using the same cam lobe form and the same 10.5 mm lift for the inlet valves as already used for the exhausts. 'On a turbo,' said Hans Mezger, 'we found that you didn't need that wide opening period for the intake valve. You got the air in with pressure, not just by tuning the opening time. The smaller valve lift and less overlapping helped improve the throttle response.'

The blown engine's cylinder heads and valve sizes were unchanged. Porsche successfully introduced inlet valves made of titanium for the first time, each of the valves weighing only 2.4 ounces. The stems of both inlet and exhaust valves were hollow for sodium cooling. Exhaust-valve stems were chromed to reduce the seizing in their guides that resulted in many destroyed test engines. Their guides were shortened so they would absorb less heat, increased in running clearance and given direct delivery of lubricating oil through a special drilling.

Fired by the same ignition system used on earlier twelves, the two spark plugs per cylinder were a platinum-tipped Bosch design. Bosch also provided the fuel-injection system. The diameters of its twelve pump plungers were enlarged to satisfy the blown engine's greater appetite.

No part of the turbocharged twelve was subject to more changes than its inlet manifolding. One feature that eventually stabilised was positioning the injection nozzles as close to the inlet ports as possible. Butterfly throttles replaced sliding throttles. Some test engines had one big throttle for each cylinder bank and in others—eventually in all—each inlet tract had its individual butterfly. At the forward ends of the two log manifolds a small pipe between them balanced their pressures.

Long feed pipes came forward to the manifolds from the two turbos, placed above and flanking the gearbox in the original Sino-American style. Carried by a structure composed of the exhaust pipes between them and some additional bracing, they were suspended from the frame at the rear. The turbochargers were like those made by Eberspächer for diesel truck engines with one exception—their shafts ran on ball bearings instead of bushings. Each had its own oil supply from the engine. Exhaust gases entering the turbine side were as hot as 1,800° F at full load. The compressed induction air fed to the engine reached a 300° F temperature in the absence of any form of intercooler.

In the early engines the boost was moderate for a racing unit—between 0.9 and 1.1 bar. This was enough to extract more than 800 horsepower from the 4.5-litre twelve. At about this level, an eight-hour durability run at full power was successfully completed in early December 1971. It was successful as far as the engine was concerned but one heard that the dynamometer was not in the best condition afterward! RT

HOW TO WIN THE DRAG RACE

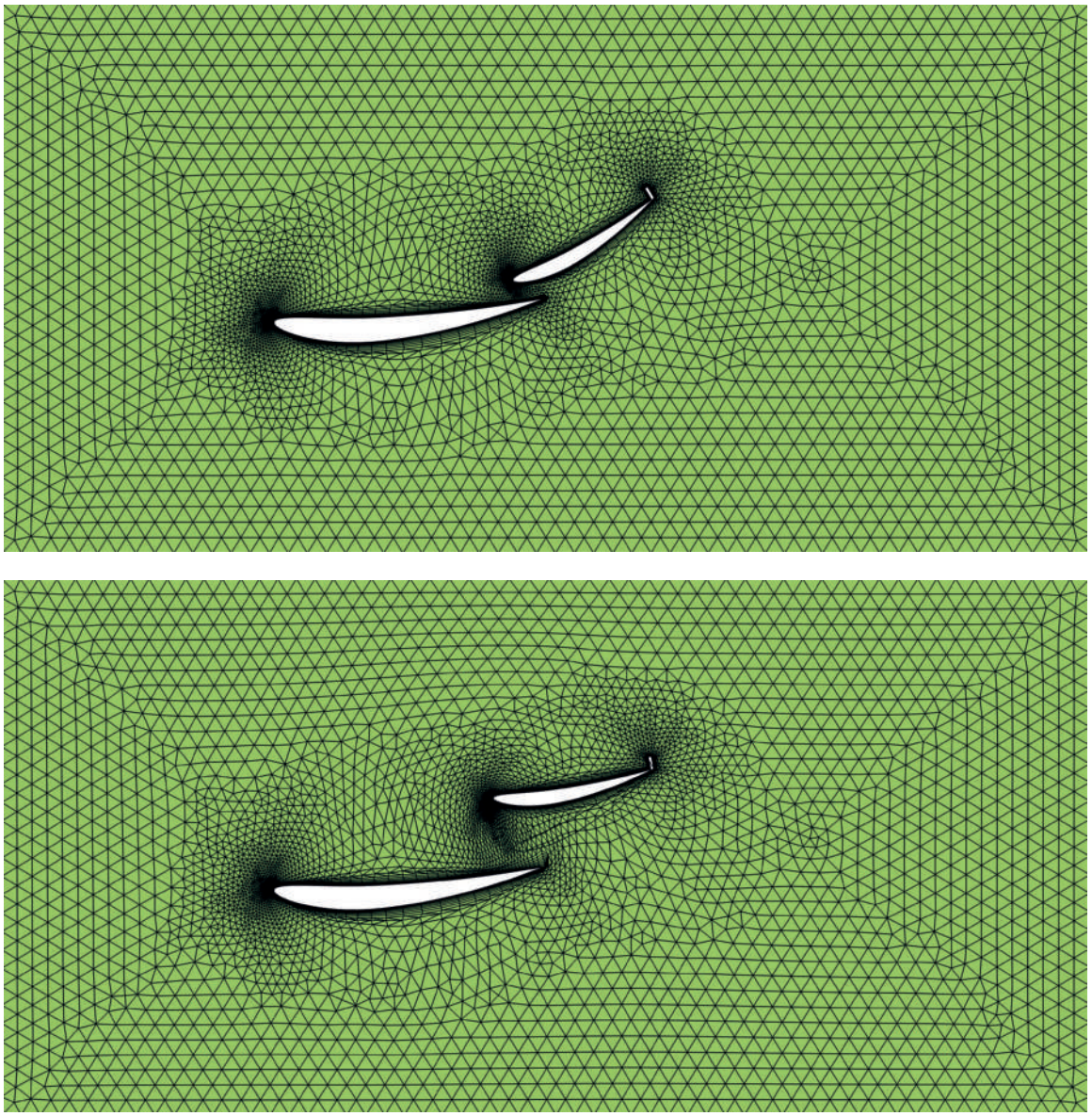
How to get the most out of Drag Reduction Systems using Computational Fluid Dynamics. By **Venkata Krisshna**, an applications engineer at American mathematical modelling software specialist COMSOL

THE five lights go out and the grand prix begins. The cars race out of their respective grid slots to the first corner. Overtakes, safety cars, and pit stops all mix up the field as the laps tick down. With the race on the line, the gap between the two leading cars shrinks to just under a second. On the next straight, the second-placed driver activates the car's Drag Reduction System (DRS), opening its rear wing, giving it a significant speed advantage. The driver closes the gap, swings out and around, and wins the race. DRS, an example of active aerodynamics, was implemented in Formula 1 racing precisely to help create moments like this.

Active aerodynamic systems are designed to increase speed, enhance handling and stability, and optimise cooling. Whether you are chasing your first win or simply cruising on the highway, active aerodynamics systems can dramatically alter your vehicle's aerodynamic profile and performance. In tandem with physical experimentation, modelling and simulation can play an important role in optimising these systems. Let's explore the effects DRS can have on a vehicle's drag and downforce using a simple model. ▶

Philip Platzer/Red Bull Content Pool

ABOVE The Drag Reduction System has enabled overtaking in Formula 1 in situations where it was rarely possible before its 2011 introduction



LEFT The simulation results in COMSOL showing the deformation of the mesh elements modelled with the DRS flap closed (above) and open (below)

Balancing drag and downforce with active aerodynamics

The two most important aerodynamic metrics in a vehicle are downforce and drag. Downforce improves a vehicle's stability and handling by pushing the car toward the ground. More downforce typically leads to more drag, which is the resistive force that opposes the vehicle's forward motion and reduces its speed and fuel efficiency. This is the relationship that automotive designers have to balance.

Active aerodynamic systems dynamically change the aerodynamic profile of vehicles to optimise their downforce and drag while they are being driven. In Formula 1, the DRS consists of an adjustable rear wing. When a driver enters one of the designated DRS areas – typically a long straight – within a second of the car in front, they can open this rear wing. This action will reduce the car's drag and increase its straight-line speed. Once out of the DRS area, the wing closes and the car regains the downforce it needs for the corners.

Using CFD to measure aerodynamic performance

Computational Fluid Dynamics (CFD) can be used in automotive design to visualise the airflow pattern around the vehicle and predict how changes will impact its overall aerodynamic performance. While the rear wing and DRS system are standardised, teams can still assess their overall aerodynamic performance to ensure that their car gets the most out of this aspect of Formula 1.

> *"The plot shows the maximum velocity of air is lower when the DRS is active"*

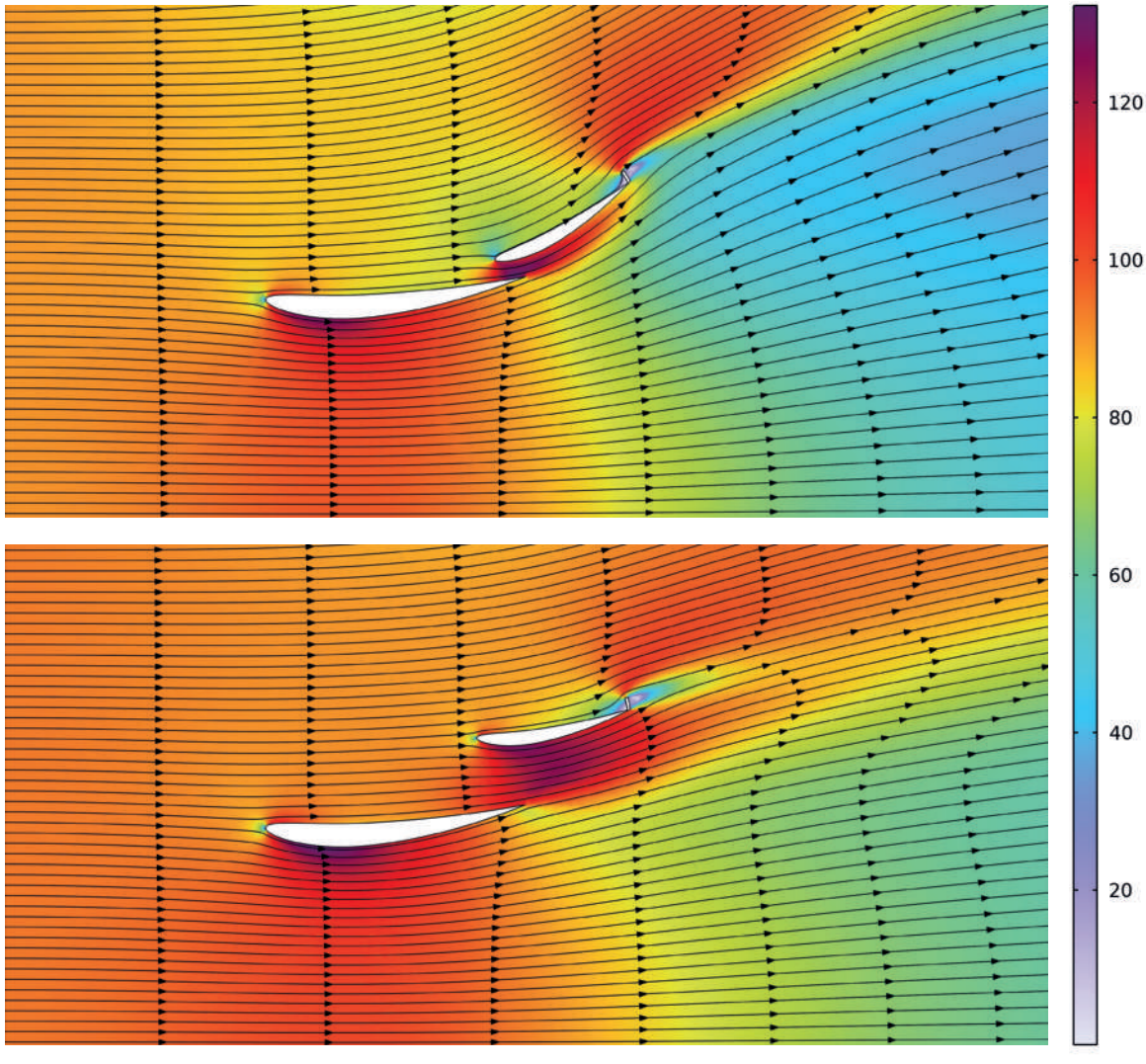
Modelling DRS

Let's now look at our model of a DRS flap similar to the ones found on Formula 1 race cars. Our goal is to quantify the change in aerodynamic drag and downforce on the rear wing during DRS operation to get a better idea of the physics behind the overtakes. Formula 1 rear wing assemblies typically consist of two wings that span the car's width, ▶

Getty Images/Red Bull Content Pool

ABOVE In Formula 1 DRS can lead to a significant straight-line speed differential between cars

RIGHT The simulation results showing the velocity profile and streamlines when the DRS flap is closed (above) and open (below)



with vertical endplates on the sides to manage airflow and reduce drag from wingtip vortices. To keep things simple, we focus on a 2D cross-section of a rear wing assembly and disregard these details, concentrating instead on the cross-sectional geometry of the two wings. An inlet and an outlet are defined at the left and right boundaries, respectively. The upper and lower boundaries are defined using the open boundary condition and slip wall condition, respectively.

We model both the upper wing and lower wing, which we refer to as the 'DRS flap' and 'main flap' respectively. A NACA 6409 airfoil is used for both of the wings. While not entirely realistic, the purpose of this model is a simple demonstration of the effect of an adjustable flap on aerodynamic drag and downforce.

The DRS flap is modelled to lift no more than 85mm from the main flap, in accordance with the relevant Formula 1 regulation. An inlet velocity of 90m/s is defined to model a race car driving at 201mph on a track. We conduct two separate studies: a stationary study to obtain the steady-state flow profile when the DRS is inactive, and a time-dependent study to simulate the transient effects of the adjustable flap. In this scenario, DRS is activated two seconds after the study begins and is active for roughly three seconds. Next, let's take a look at the results.

BELOW DRS is set to be made obsolete in the 2026 F1 season, being replaced with active aerodynamics front and rear. A manual override system, offering drivers more electrical energy, will facilitate overtaking

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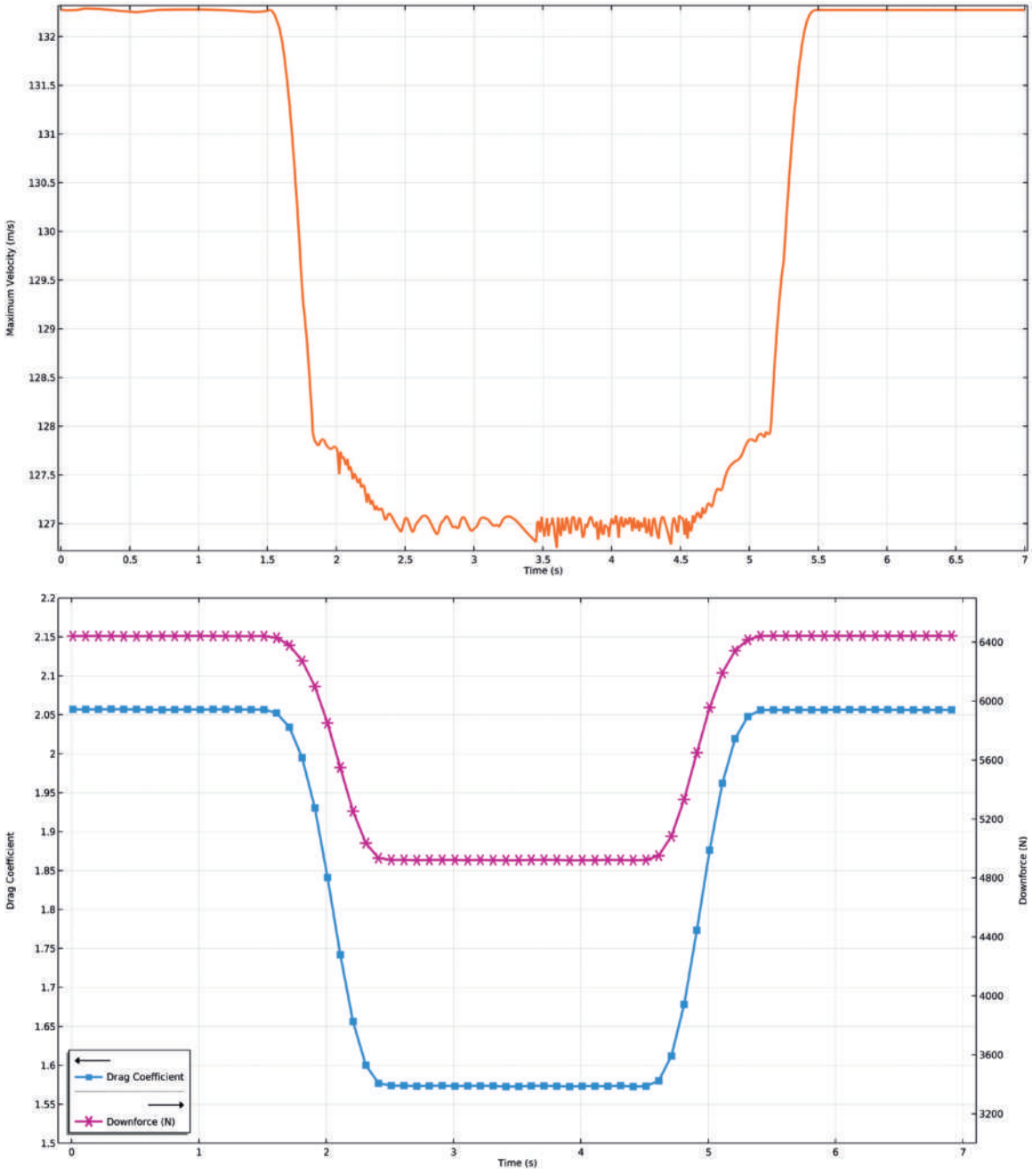

RIGHT The simulation results showing the maximum velocity of the air before, during, and after DRS activation (above) and the drag coefficient and downforce during DRS operation (below)

The Effects of DRS: Going for the Wing

First we see how the mesh deforms with the movement of the DRS flap as it goes from closed to open. The model illustrates the extent to which the DRS flap lifts from the main flap. A 19.5 degree rotation of the DRS flap results in a 84mm lift from the main flap, which is within regulation.

Second, we see the velocity streamlines during the operation of the DRS. The plot shows that the maximum velocity of air is lower when the DRS is active. This should not be confused with the velocity of the car, which will be higher when the flap is raised.

Further we see that the drag coefficient of the rear wing decreases by up to 27.1% and the downforce on the flap shows a decrease by up to 23.6% when the DRS is activated.

The real-life application of DRS can have a significantly more substantial effect on drag. For instance, in Formula Student competition vehicles, DRS has been shown to reduce drag by up to 78%.

Extending CFD in Active Aerodynamics

Active aerodynamic systems such as DRS provide significant benefits to high-speed cars – and they have also become popular in road-legal vehicles. Using a simple cross-sectional 2D representation of the rear wing assembly of a race car, we were able to observe the impact that an adjustable flap has on a car's drag and downforce. Such models can be used by engineers to better understand the principles of CFD and highlight the exciting applications of aerodynamics in vehicle design. Those investigating the impact of air on their designs can add more complexity by exploring the structural deformation of various parts of the wing. RT

END OF THE WORLD?

Hal Ridge assesses the demise of FIA World Rallycross as a global series and weighs up the chances that it could yet make a speedy return

A turbulent period for the World Rallycross Championship – at one stage motor racing's fastest growing discipline – came to a head on the eve of the 2025 season finale in Istanbul. On the back of another challenging campaign, the FIA announced that the mixed-surface racing series will lose its coveted World Championship status for 2026, reverting to being a European series with the much-discussed electric cars being dropped from the roster.

Conceived out of the European Rallycross Championship in 2014, World RX's early years were stacked full of momentum and growth, attracting big name drivers, teams and manufacturers to the party. Those heady times now seem a distant memory: the switch to electrification has been complex and not drama free, the commercial rights have changed hands more than once and most recently, entry numbers have dwindled, with just four cars entered for the 2025 finale.

Mass migration

The whys and wherefores of how this made-for-TV discipline has got to this point are lengthy and intricate but they can partly be traced all the way back to July 2017, when Mercedes announced its departure from DTM. That decision, a substantial distance away from rallycross, was arguably the start of a butterfly effect.

At that time, alongside a number of manufacturers already involved in World RX, then promoter IMG and the FIA were forging ahead with plans for 2020 to make a switch to electric technology at rallycross' highest tier. It is after all the perfect discipline for the technology, with races run over a maximum of six laps.

But come crunch time in 2018, when three marques were required to sign up to the plan for an all-new chassis and powertrain concept, Audi left the table to support DTM once fellow stakeholder Mercedes departed. Peugeot then left the World RX discussions when the electric transition was postponed for a year in a bid to raise more interest... before, as the last brand standing, Volkswagen followed suit.

World RX still delivered one of its most competitive seasons on track in 2019 with privately-run teams, while new plans were formed for an electric endeavour to be based more around the exciting cars than the previous manufacturer-led concept.

Coronavirus played its part in delaying things further, while a new FIA tender for 14 electric powertrain kits was won by Austrian firm Kreisel. After further complications and delays, including a change of commercial rights holder from IMG to an offshoot of WRC Promoter, electric cars – which had reportedly cost over a million euros each to build – hit the circuits for the first time in the summer of 2022.

> *"World RX's early years were stacked full of momentum and growth, attracting big names"*

The relatively noiseless machines were poorly received by the traditional hardcore fan base, but the numbers slowly grew in year one until the grid was up to 10 cars by the start of 2023. The famous incident on the eve of round three at Lydden Hill, ironically the birthplace of the sport – where Sébastien Loeb's Special One Racing Lancia Delta, team transporter and sister car were destroyed by a fire in the paddock – meant the season eventually concluded using second-tier RX2e cars, including a hugely-successful inner-city race in Hong Kong.

As the headline RX1e cars returned for 2024, a 'battle ▶

BELOW The FIA World Rallycross Championship has reached the end of the line, being downgraded to a European series from 2026

FIA

Hal Ridge

Tom Banks

LEFT The global series was conceived out of the European Rallycross Championship, pictured in its final season in 2013

LEFT Petter Solberg won the very first round of the newly-created 2014 FIA World Rallycross Championship in Portugal, going on to take the first two world titles

BELOW Bump in the road: Turkey's round of the 2025 FIA World Rallycross Championship will be its last, at least for now

of technologies' concept was brought in, pitching previous-generation internal combustion Supercar (RX1) machines against the incumbent EV machines in a bid to improve grid numbers. Even so entries were not as forthcoming as hoped and, coupled with other problems, Rallycross Promoter was shown the door by the FIA at the end of the year, its contract terminated.

Balance of power

A complicated, winter-long tender process to find a new commercial rights holder ultimately resulted in the FIA taking the series on itself for 2025. The governing body made a huge effort pre-season to establish a more balanced EOT (equalisation of technology) aiming to achieve a parity between ICE and EV; an issue that had upset some teams in 2024. A free-to-air broadcast package – for which fans had been crying out – was also resurrected.

> *"It was very, very expensive to build the electric cars, and the fans didn't like it at all"*

Yet, on the eve of the Istanbul Park double-header season finale, the FIA announced that it would draw a line under the RX1e electric concept and return to ICE-only for 2026, along with withdrawing the series' World Championship status.

"We realised quite early that we had to do something different because electric was not that popular, for different reasons. We didn't get the backup from the manufacturers we expected; we were working with Volkswagen but at that time there was no interest and it was not a success. It was also very, very expensive to build the cars, and the fans didn't like it at all," says Tommy Kristoffersson, Team Principal of the Kristoffersson Motorsport team that has won the last four World RX Team crowns, with both EV and ICE machines.

"When we understood that nobody would build new electric cars and enter, we had to take in combustion cars for the battle of technologies. At that time there was a lot of lobbying and discussion that it was a big advantage to run an ICE car [which KMS was running]. We'd long known it was faster with the EV cars than with the combustion cars because we had both, but we had a very good contract with Aurobay and Horse Powerchain so it worked super well for us to run the ▶

FIA

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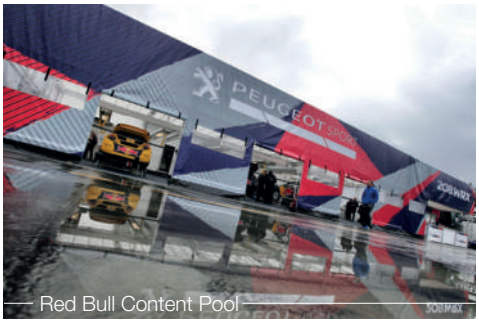
combustion car. But for 2025 the FIA should have done a better job with EOT at the pre-season test in Portugal. As soon as we got the EOT decisions, we realised ICE would never work for us if we wanted to compete for the championship."

Feeling that the EOT implemented didn't do enough to restrict the electric powertrains, in part due to start line performance, KMS ditched its ICE Volkswagen Polos after the season-opener and returned to its previous EV machines. At the time that move was seen as KMS exploiting a loophole in the rules that allowed it to switch technologies on one occasion in the year. But the knock-on was the perception that if KMS and one of the greatest drivers on the planet in any discipline Johan Kristoffersson (now an eight-time World RX title-winner) couldn't win in an ICE machine, what hope did anyone else have?

> *"We made many mistakes to get where we are – and we could have avoided some of them"*

"You couldn't simply take away the power from electric cars because we weren't using all the power anyway," adds Tommy. "So if we just cut off some of the power we'd still be at the same level; it didn't hurt at all. At KMS we came up with an easy solution but that's not what happened – and I think that disqualified all the combustion cars that wanted to enter. If they could see we couldn't make it work, they didn't believe they could either. Then we also lost ▶



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LEFT AND FAR LEFT Peugeot's paddock facilities show just how seriously the big players took the series before their departure

BELOW In its heyday FIA World Rallycross featured major manufacturers including Audi, Volkswagen and Peugeot

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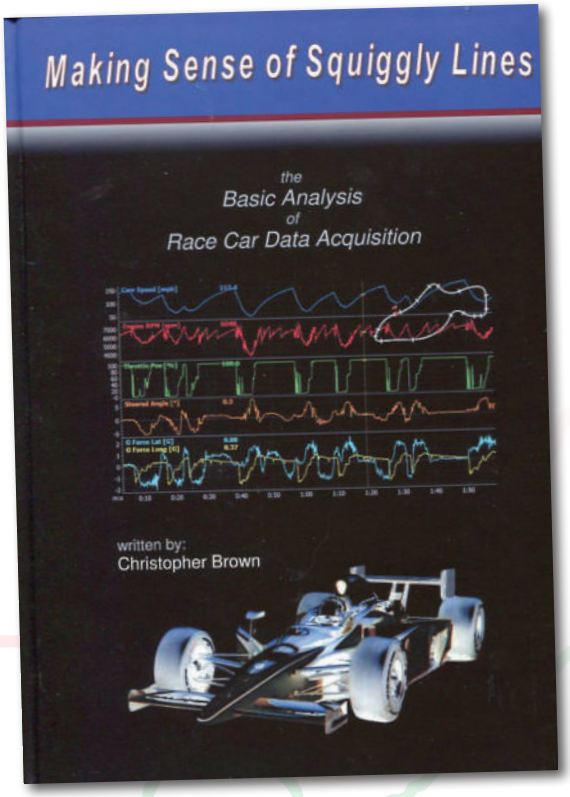

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Tom Banks

Hansen Motorsport [an electric team, through loss of sponsorship]. But we created some of the problems ourselves because we weren't fair enough to realise we needed combustion cars to be involved to avoid killing off the championship. We should have known that better in the first place.

"Some of the EV teams didn't want to have any ICE cars with non-homologated software and no sustainable fuel. In my opinion that was not right, because we needed them. For those people at that time, they didn't have the money and they didn't like to risk engines [with re-mapping for different fuels]. We defended our ideas a bit too much and suffered in terms of offering the possibility for others to join – though of course it's easy to look back and say: 'We should have done this, this and this.' When we went for electric, I also believed it was the right way to go because I thought that was what the market asked for. Even companies like [KMS main sponsor] Bauhaus said: 'We cannot support you if it don't go electric.' At that time it was what everyone was talking about. But the conclusion is that we made many mistakes to get where we are today. And we could have avoided some of them if we'd been a bit smarter, but we were not."

It's not all doom and gloom, though. Almost too late to save World RX in its current guise, grids for the European and World Championship classes were mixed at the Turkish finale because the world division had such a poor entry, before the two were split into their own series again for the critical semi-finals and finals. The action on track was an improved spectacle and the move proved to be a great success among teams, drivers and fans.

ABOVE Hansen Motorsport was one of the teams that went down the RX1e electric route, but the cars were expensive and far from popular with the sport's fanbase

Rallying the troops

The FIA's announcement two days earlier also revealed its intention to run a standalone World Cup event next year outside Europe after the European Championship's conclusion. This would use the technical regulations outlined in ▶

BELOW Sébastien Loeb's Special One Racing Lancia Delta, team transporter and sister car were destroyed by a 2023 fire in the Lydden Hill paddock

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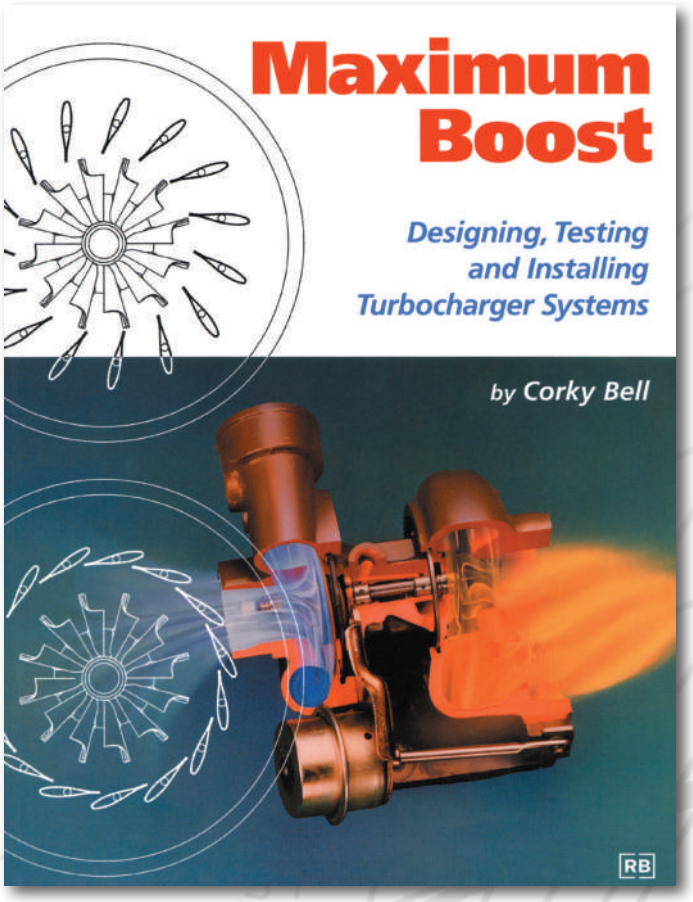

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Kristoffersson Motorsport

RT298, aimed at falling in line with the new World Rally Championship. Importantly, that reference to the new regulation set gave a potential timeframe for a return to World Championship status.

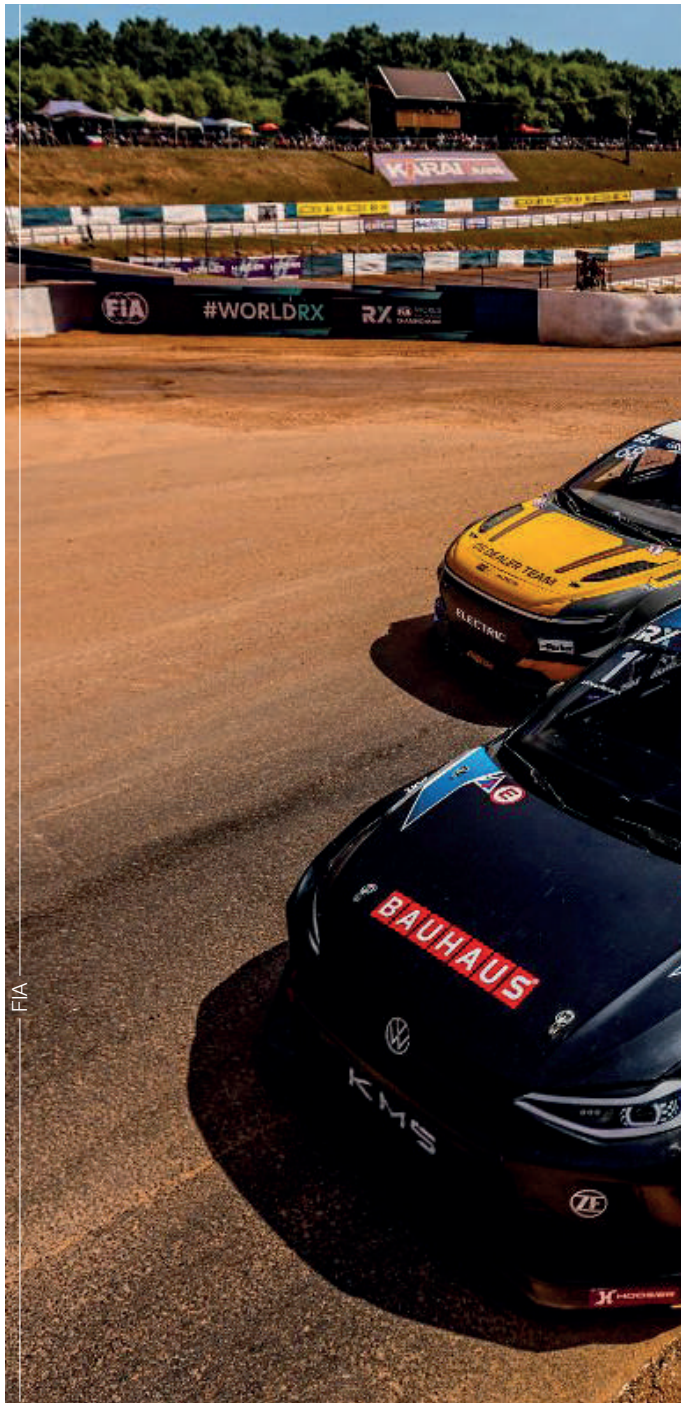
"These changes form part of the FIA's long-term vision that will create a sustainable and exciting rallycross competition," read the FIA's statement. "For 2028, the new technical regulatory framework being applied in the FIA World Rally Championship's top category will be applied in rallycross, meaning modern, safer, more affordable, yet faster vehicles will become available over the subsequent seasons with the aim of attracting more competitors, and the logical return for a World Rallycross Championship with full and exciting grids."

Manufacturers wanted

While the new plans have largely been met positively by fans, losing World Championship status for any discipline can't be taken lightly. Certainly, at least three of the drivers racing in the Turkish finale were professional in the pure sense of the term, being paid to race. With the Volvo Construction Equipment Dealer Team gone as their focus is on electric propulsion, at least two of those have been handed their rallycross P45. It's hard to see rallycross being anything other than a driver-funded model for the immediate future. Equally, when the World Championship has been at its strongest, rallycross at every level has benefited, right down to the Junior classes in the national series.

After all, karting is as strong as it is because there is a glimmer of a dream for almost all involved that they may be the new Lewis or Max. In rallycross, back in 2018, that aspiration was to be the next potential Johan Kristoffersson, Andreas Bakkerud or Timmy Hansen.

ABOVE Tommy Kristoffersson congratulates son Johan after he won a record eighth FIA World Rallycross Championship in Turkey


FIA

RIGHT Few other motorsport series can come close to rallycross in terms of the intense bursts of tight racing on offer

BELOW Flying battles: Johan Kristoffersson and Niclas Grönholm take to the skies

FIA

Tommy Kristoffersson is adamant that whatever the rule set going forward, and however the sport looks, it needs manufacturer involvement to reach the heights that so many believe the discipline can return to and even supersede. He's well qualified to comment, having run both OEM-backed and private teams in various series.

"If we go back to the really good old days, rallycross is a very open sport," he says. "You have what you have, you build something in the garage over the winter, you go to a race track and you compete. That's rallycross. To get the manufacturers back in the future, you should actually come and drive with whatever you have. You could have hybrid, combustion engine, electric... but there has to be control over the EOT. To get the sport back on the right level again, it should be open, because then you can attack manufacturers."

Given how rallycross works, that can be done relatively inexpensively, compared to other global series.

"If you want to enter an FIA World Championship, you have Formula 1, very expensive; Rally, quite expensive; Rally Raid, very expensive; WEC, very expensive," he adds. "But if a manufacturer has some interest in motorsport, if they spent €5 million in rallycross they could be competing in an FIA World Championship with two cars. If I was in the FIA, I would try to attract all the different manufacturers because when we get them on board we'll have the platform we need. We can run with whatever rules, as long as we have manufacturers. So I'd go to them and ask how they want it to be. What can we do for them to get them to enter?"

> *"If we go back to the really good old days, rallycross is a very open sport"*

While KMS is uncertain of its immediate future in rallycross, it is evaluating all options. Indeed, as Race Tech went to print, the squad was about to be announced as contesting the first Extreme H World Cup in Saudi Arabia. Having outlined some of those alternative options at length, Tommy paused before concluding: "...but it's not really the same. It doesn't get your heart pumping in the same way as rallycross."

There is absolutely no doubt that a European Rallycross Championship can be well supported next season. That's not just based on hope, but based on the amount of entries in the World RX undercard in recent series coupled with the quantity of eligible cars in regional and domestic championships. And when the grids are good, by its very nature, rallycross excels.

The discipline retains incredible potential. It's more perfect than ever for the attention-span-limited, quick-fix-seeking under 30s of the current era. It is ideal for hosting corporate guests who can get up close and personal to both the people and the action in a single location. And it is, by its very makeup from its very humble beginnings, made for TV.

For those reasons, coupled with the rich passion of those working in the discipline, rallycross deserves to return to World Championship status as soon as possible. RT

STEPPING INTO THE TIME TUNNEL

Why Max Verstappen's 'weekend off', racing a GT3 car at the Nürburgring, reminded **Sergio Rinland** of the spirit he encountered at Goodwood

CONTINUING my annual pilgrimage to historic motorsport, last month's destination was the Goodwood Revival – a truly spectacular celebration of racing's past. This year, two themes stole the spotlight: Alfa Romeo and Jim Clark.

The Alfa Romeo display was superb, showcasing machinery from the marque's earliest days through to the stunning Giulia GT and GTA models of the late 1960s, my favourite Alfas.

The Jim Clark tribute was equally moving. We were honoured by the presence of his friend and protégé, Sir Jackie Stewart, alongside a remarkable collection of cars that Jimmy drove during his all-too-brief career. Many of these were arranged in a newly created paddock area beside the Lavant Straight.

The star of that paddock was an early example of the Lotus 49, still in its original Lotus green with yellow stripe, sensitively developed by Graham Hill and, fittingly, driven at Goodwood by his World Champion son, Damon.

I was in awe of the car's elegant simplicity, as I always am when I see it. Damon, after his demonstration laps, looked like a child with a new toy, his joy infectious. Neither of us could wipe the smiles from our faces.

The breadth of cars Jim Clark drove is astonishing. From his early days in a Porsche 356 and a two-stroke DKW, to his peak in Formula 1, he found time to race Touring Cars like the Lotus Cortina and Ford Galaxie; GT cars including Aston Martins, Jaguars, and the Lotus Elan; Sports Cars such as the Lotus 23 and the infamous Lotus 30, which he also campaigned in the USRRC (precursor to Can-Am); USAC Indy Cars, winning the 1965 Indianapolis 500 with the Lotus 38; and the Tasman Series in Australia and New Zealand during the European winter.

It is worth remembering that back then, the Formula 1 calendar featured only 10 races per season, and the pay cheque was nowhere near today's standards. To make a living, drivers had to race anything that came their way. If we were to tally the cars driven by some of today's F1 drivers, we would end up with just four: a Tatuus Formula 4, a Dallara Formula 3, a Dallara Formula 2, and their current F1 car (we will exclude Fernando Alonso from that list).

That is why it was so refreshing to see the reigning World Champion, Max Verstappen, behind the wheel of a GT3 car last month. He had to complete a rookie test at the Nürburgring Nordschleife, an experience not unlike Jim Clark's rookie test at Indianapolis, even after Clark had already won the F1 title. A bit of humble pie never hurt anyone. Hats off to Red Bull for allowing it; I hope other teams and drivers follow suit.

Returning to the Revival, it is always a joy to see so many fascinating cars from that golden era. It truly feels like stepping into a time machine, back to that magical period between 1947 and 1967, straight out of The Time Tunnel, the sci-fi TV series of the 1960s.

BELOW It was an emotional moment when Damon Hill drove his father's car at Goodwood

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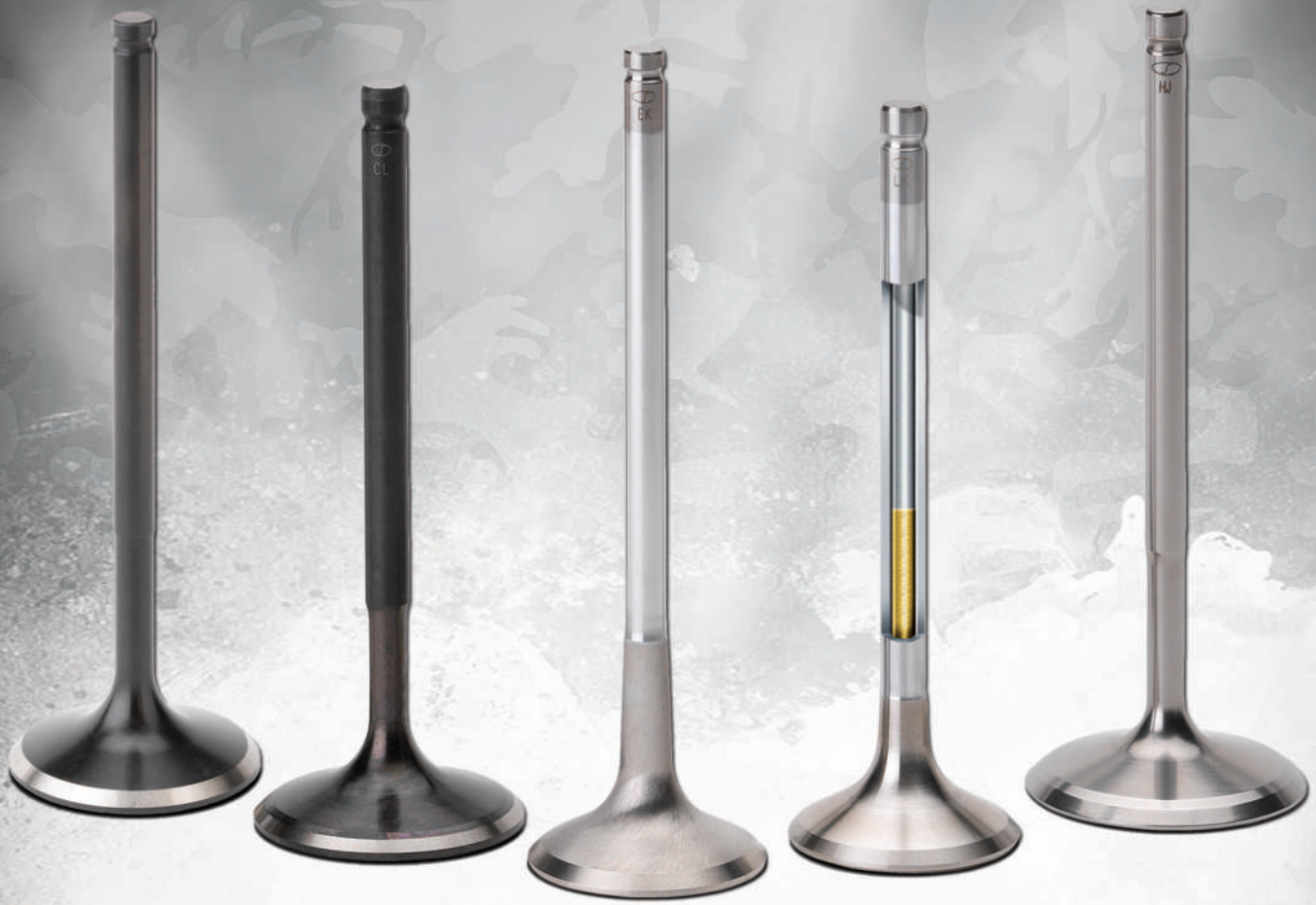

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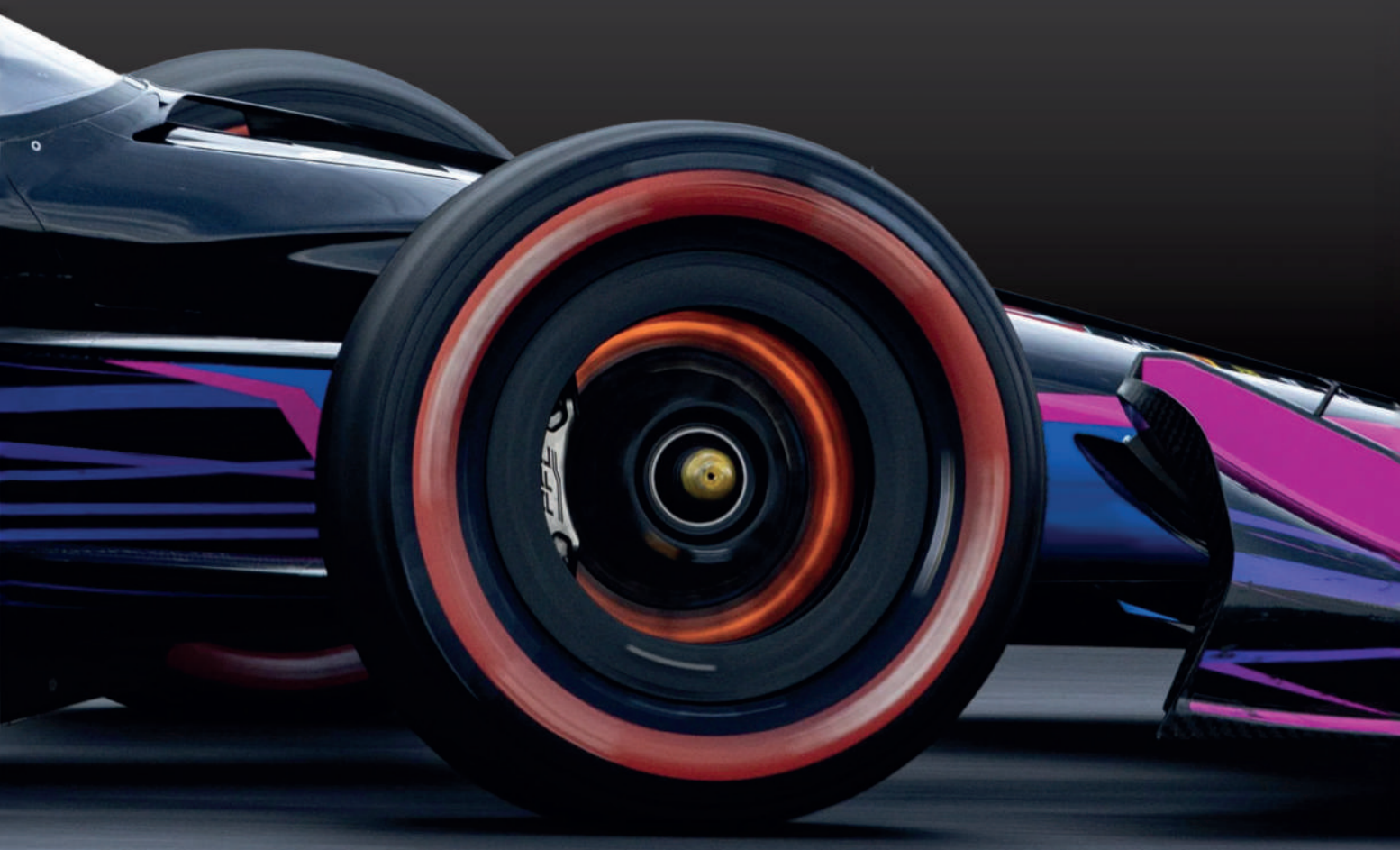

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